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The GM-Lewis Truce

AMA Sales 269,839

Last Month Ranked as Second Best January

Factory sales of Automobile Manufacturers Association members amounted to 269,839 units in January, the association announced today.

On the basis of this report, last month's operations resulted in the second highest January factory shipments —only exceeded by the record of January, 1936, when factory shipments amounted to 276,451 units.

Last month's factory shipments were 67 per cent above the five-year January average although they were 33 per cent under the total for December, 1936.

The association's report, covering the operations of all but one of the major producers of motor vehicles in the United States, shows that the sale of 269,839 cars last month compares with 400,159 in December and 276,451 in January last year.

Chrysler Wages Lifted

General Increase of 10% Is Fourth Since 1933

Wage increases totaling $13,000,000 to $14,000,000 annually were announced Feb. 9 by the Chrysler Corp. The average increase, on the basis of last May's wage boost, is estimated at 10 per cent per employe.

The latest Chrysler wage increase will apply to all Detroit shop workers of the various divisions. About 60,000 hourly wage workers of the 67,000 employes of the corporation will profit from the increase, it was stated by a company official. The formal statement issued by the corporation read as follows:

The wage increase was the fourth advance in pay for Chrysler employes since August, 1933, when wage rates

(*Turn to page 216, please*)

Resumption of Work to Be Hastened

The agreement between the General Motors Corp. and the United Automobile Workers of America provides that the two parties will commence collective bargaining negotiations Feb. 16 looking to a final and complete settlement of all issues in dispute.

The corporation recognizes the U.A.W. as the collective bargaining agency for those of its employes who are members of the union. The company agrees to call back to work all strikers and to show no discrimination against any employe because of his union affiliation or activities.

The strike is to be terminated immediately and all plants occupied by the strikers are to be evacuated.

(Complete details of the strike settlement appear on the following page.)

This Week

The farm tractor has evidently "been going places" and Harry G. Davis paints a very graphic picture of the "before and after" types. Turn to page 218.

Hector Rabezzana and Stephen Kalmar treat the subject of spark plug gaps in a way that will arouse wide interest. See page 222.

P. M. Heldt describes the new "Electrogear" on page 226. The article is liberally illustrated and he makes it all quite simple even to the laymen.

The Chevrolet commercial body plant is accomplishing many things in new ways. Joseph Geschelin tells all about it on page 230.

Capacity Output Ahead

New Spring Production Records in Prospect as GM Resumes

By Harold E. Gronseth

Settlement of the GM strike completely changes the production outlook for the automobile industry. With the manufacture of GM cars to begin on Monday and with the promise of capacity operations in 12 days, all forecasts of February output by the industry must be raised. Prospects are also bright for March production to set a new high since 1929, exceeding the 1936 peak of 527,726 units reached in April. Half-million unit months will be in order for some time, probably throughout the entire second quarter.

With a tremendous bank of unfilled orders on their books, GM divisions are expected to maintain maximum operations out into the summer. Capacity of the corporation's U. S. and Canadian plants is 225,000 units a month.

February schedules of companies other than GM called for a minimum of 300,000 units in February or as many as were turned out by the entire industry in February last year. What the corporation's contribution will be to the current month's output cannot be estimated at this time, but since capacity is to be reached in 12 days, or by the end of the month, a sizable production can be turned out during this interval of ascending operations.

The automobile industry is within two weeks of the time when dealers' stocks should be at the year's peak, and with GM out of production for the greater part of the period since Jan. 1, a substantial deficiency exists. In preparation for the spring selling season, stocks in the field normally mount to a high point by March 1, remain stationary for about a month while production and sales are in balance, and then gradually decline from April to

(*Turn to page 216, please*)

Strike Ends, GM Rushes Production

All Possible Plants Will Be Running by Monday, Capacity Operations Scheduled, Says Knudsen

Governor Murphy broke the news of the strike settlement at 2:35 Thursday morning, with the words, "An agreement has been reached."

Emerging from the conference finally held in Lewis's hotel room, John Thomas Smith, of GM, said in French, "C'est fini."

"Now I can sleep for a while," Lewis commented, as he pulled a blanket up around his chin.

The governor then issued the following statement:

"An agreement has been reached under the terms of which the union agrees to end the strike. The signing of the agreement will be made later today at the Recorder's Court Building. The terms will then be announced. All parties will be present.

"Mr. Lewis and his associates and the three representatives of General Motors have contributed all that they could in earnestness and with fairness to bring to a conclusion this great industrial conflict. I gratefully thank them.

"It is another great duty of mine to acknowledge the wise counsel and assistance of James F. Dewey, federal conciliator.

"It has been a difficult job, but reason has prevailed.

"We hope it will serve toward ending forever in the U. S. anything but peaceful, reasonable and conciliatory methods. This will be an enduring peace."

A moment later the governor added that Frances Perkins, Secretary of Labor, has been "very helpful."

President Martin Absent

Settlement of the strike came while Lewis was confined to his room in the Statler Hotel with influenza. Conferences were moved to the presidential suite in the Statler, Wednesday morning. Messengers kept Lewis in constant touch with conferences, and Governor Murphy shuttled back and forth between Lewis's room and the conference. It was a coincidence that the two leading figures on the union side were both absent from the conference room in the final stages of the negotiations. Homer Martin, UAW president, being on a speaking tour.

General Motors plants will be back in full production in about 12 days, W. S. Knudsen, executive vice-president, stated in a press conference following the signing of the agreement which ended the strike. "We will start all the plants we can Monday and then string along as fast as possible thereafter," he said.

Knudsen expects production of his corporation's plant to reach the capacity of 225,000 units in March, and that peak operations will continue well into the summer. "That is the only way we can make up the time we have lost," he said. "We have a tremendous backlog of unfilled orders on hand. Many people have written us that they will wait for our cars."

C. E. Wilson said he thought it might be possible to get a few plants going this week but no car production would get underway until Monday. Mr. Wilson stated that he was told by Wyndham Mortimer, first vice-president of the UAW, that the plants held by strikers in Flint would be evacuated Thursday afternoon and evening.

Negotiations on issues specified in the union's letter to the corporation on Jan. 4 will be started Feb. 16, the conferences to be held in the General Motors building in Detroit. Mr. Knudsen said he did not know how long it would take to clear up the points in question but did not believe the negotiations would require as much as the 15 days allowed in the Lansing agreement which was broken when both sides charged bad faith. The question of exclusive bargaining will not be taken up in these conferences.

"Lewis insisted on that point being settled before evacuation of the plants," Mr. Knudsen explained. Sessions are to be brief, probably about 2½ hours. "We have found that is the best way to handle it," Knudsen said. "Nothing can be accomplished when both sides become tired in long sessions."

Governor Murphy has said he is willing to set in on further conferences if requested by either side," Knudsen said, "but we think he has spent enough time. He should be allowed to run the state for a while."

Knudsen praised the part played by Governor Murphy in the negotiations as well as that of James F. Dewey, Federal conciliator. General Motors will be represented in the negotiations by W. S. Knudsen, C. E. Wilson, vice-president and assistant to Knudsen, and H. W. Anderson, head of the industrial relations department of the corporation.

Knudsen explained that the "6 months provision" referred to in his letter to the Governor does not mean that the union will be given the right to exclusive bargaining for that period. The corporation agrees only that it will not bargain or enter into agreements with any other union or representative of employes of plants on strike in respect to matters of general corporate policy without first submitting the facts of the situation to the Governor, who will act as arbiter on the question of good faith.

A statement issued by Lewis was as follows:

"Another milestone on labor's march. The agreement establishes collective bargaining and security for the union. It institutes for the first time a rational relationship in the automobile industry. The precision and efficiency of their strike has been magnificent. Their devotion and self sacrifice is rewarded. They can now perfect their union and go forward. Governor Murphy has contributed greatly to the settlement. The nation is the beneficiary of his statemanship."

Text of the Agreement

The text of the agreement entered into Feb. 11, 1937, between the General Motors Corp. and the international union, United Automobile Workers of America follows:

1. The corporation hereby recognizes the union as the collective bargaining agency for those employes of the corporation who are members of the union. The corporation recognizes and will not interfere with the right of its employes to be members of the union. There shall be no discrimination, interference, restraint, or coercion by the corporation or any of its agents against any employe because of membership in the union.

2. The corporation and the union agree to commence collective bargaining negotiations on Feb. 16 with regard to the issues specified in the letter of Jan. 4, 1937, from the union to the corporation for the purpose of entering into a collective bargaining agreement or agreements covering such issues looking to a final and complete settlement of all matters in dispute.

3. The union agrees to forthwith terminate the present strike against the corporation and to evacuate all plants now occupied by strikers.

4. The corporation agrees that all of its plants which are on strike or otherwise idle shall resume operations as rapidly as possible.

5. It is understood that all employes now on strike or otherwise idle will return to their usual work when called and that no discrimination shall be made or prejudice exercised by the corporation against any employe because of his former affiliation with, or activities in, the union or the present strike.

6. The union agrees that pending the negotiations referred to in paragraph 2 there shall be no strikes called or any other interruption to or interference with production, by the union or its members.

7. During the existence of the collective bargaining agreement contemplated pursuant to paragraph 2 all opportunities to achieve a satisfactory settlement of any grievance or the enforcement of any demands by negotiations shall be exhausted before there shall be any strikes or other interruption to or interference with production by the union or its members. There shall be no attempts to intimidate or coerce any employes by the union and there shall not be any solicitation or signing up of members by the union

on the premises of the company. This is not to preclude individual discussion.

8. After the evacuation of its plants and the termination of the strike the corporation agrees to consent to the entry of orders, dismissing the injunction proceedings which have been started by the corporation against the union or any of its members or officers or any of its locals, including those pending in Flint, Mich., and Cleveland, Ohio, and subject to the approval of the court to discontinue all contempt proceedings which it has instituted thereunder.

Commenting on the strike settlement, Alfred P. Sloan, Jr., president of General Motors, said:

"General Motors is gratified that by the unremitting efforts of Governor Murphy an agreement has been made under which the General Motors plants now illegally held by strikers will be evacuated forthwith, the strike terminated and production resumed at once.

"This agreement covers the extent of recognition which General Motors will extend the United Automobile Workers of America and the terms under which General Motors will undertake to negotiate with that union on the issues which it raised in its letter of Jan. 4. The substance of this agreement to negotiate with the UAW is as follows." Here Mr. Sloan resumed briefly the terms of the agreement.

"The above agreement," Mr. Sloan continued, "as to the terms under which General Motors will negotiate with the UAW is in complete support with the principles upon which GM has stood since the beginning of this unfortunate controversy, which like all industrial disputes which interfere with the production, has resulted in a staggering loss to everyone concerned. It affirms the rights of the representatives of any other group to negotiate in their own behalf, and we will continue our policy that any benefits extended in a settlement with any one group will be accorded to all other employes in similar circumstances in the plants to which that settlement applies.

"The corporation, its workers and the public are indebted to the Hon. Frank Murphy, assisted by Federal Conciliator James F. Dewey, for his untiring and conscientious efforts as well as the fairness with which he has handled a most difficult situation. Only his efforts have made it possible to resume work at this time."

Roosevelt Praises Murphy

President Roosevelt wired congratulations to Governor Murphy, saying: "Yours has been a high public service nobly performed for which I desire to express the thanks of the nation."

William Green, president of the AFL, said that the whole of labor is injured when one division of labor's army sustains defeat. Asked if he considered the agreement a defeat, he replied: "If you go on strike for one demand and then give it up after 40 days, what do you think it is?"

Knudsen's Letter

The letter addressed to Governor Murphy by William S. Knudsen read as follows:

"Dear Governor:

"We have been told that the UAW in justifying its demands for bargaining privilege states that they fear that without protection of some kind we might deliberately proceed to bargain with other organizations for the purpose of underminding the position of this particular union. We have said that we have no such intention.

"On the other hand we cannot enter into any agreement with anyone which can have the effect of denying to any group of our employes the rights of collective bargaining to which it is entitled and which fails to protect them in the exercise of those rights.

"On our part, therefore, we undertake not to seek or to inspire such activities on the part of other groups for the purpose of weakening this particular union. This undertaking we assume on condition that the union refrain from coercion and intimidation inside and outside of the shops in its efforts to increase its membership.

"As evidence of our intention to do all we can to hasten the resumption of work in our plants and to promote peace, we hereby agree with you that within a period of six months from the resumption of work we will not bargain with or enter into agreements with any other union or representative of employes of plants on strike in respect to such matters of general corporate policy, submitting to you the facts of the situation and gaining from you the sanction of any such contemplated procedure as being justified by law, equity or justice towards the groups of employes so represented.

"Yours Respectfully,
"W. S. Knudsen."

Back to Work

Here are some of the fortunate General Motors workers who went back on the payroll when the Chevrolet gear and axle plant in Detroit resumed part time operations last week. This scene is typical of what will happen next week when GM resumes assembly operations.

GM Increases Wages

New Scale Will Add $25,000,000 to Corporation's Payroll

An increase of five cents an hour in all General Motors plants in the U. S. was announced by Alfred P. Sloan, Jr., president, Feb. 11. The wage increase will amount to a total addition of $25,000,000 annually to the company's payrolls. The corporation's wage rate, including the latest increase, will be approximately 25 per cent in excess of the highest in effect before the depression. Mr. Sloan's announcement follows:

"In view of the corporation's expressed policy of maintaining at all times the highest justifiable wage scale, and in harmony with other increases that have just been made in the automobile industry, it will again increase wages five cents per hour in all plants in the U. S. now in operation as of Feb. 15, 1937, and in all plants not now in operation at such time as same may be reopened.

"Detailed announcements will be made on an individual plant basis.

"The total increase in wages to be dispersed on a normal yearly basis as the result of the proposed new increases now being put into effect will be $25,000,000."

Registrations Gained 24% in '36

GM Had Biggest Slice with 43% of Total, While Independents' Share Neared 10%

New Passenger Car Registrations

	December 1936	November 1936	December 1935	Twelve Months 1936	Twelve Months 1935	Per Cent Change, 12 Mos., 1936 over 1935	Per Cent of Total Twelve Months 1936	Per Cent of Total Twelve Months 1935	Two Months 1937 Models	Two Months 1936 Models	Per Cent Change
Chevrolet	80,552	63,094	63,785	930,250	656,698	+ 40.8	27.33	23.94	143,646	121,164	+18.8
Ford	63,367	27,694	54,594	748,554	826,519	− 9.5	21.99	30.12	91,061	111,172	− 18.0
Plymouth	46,677	42,726	32,531	499,580	382,985	+ 30.3	14.68	13.96	89,403	62,852	+ 42.2
Dodge	23,733	18,505	16,979	248,518	178,770	+ 39.1	7.30	6.52	42,238	32,876	+ 28.5
Oldsmobile	19,727	4,591	14,212	178,488	149,375	+ 19.6	5.25	5.44	24,318	27,568	− 11.7
Pontiac	19,405	12,694	11,011	171,669	140,122	+ 22.4	5.04	5.11	32,099	22,420	+ 43.0
Buick	21,485	16,200	12,291	160,687	87,635	+ 83.6	4.72	3.19	37,685	24,903	+ 51.5
Terraplane	8,197	5,381	6,037	78,471	53,838	+ 45.9	2.30	1.96	13,578	9,999	+ 35.8
Packard	7,529	6,963	4,160	68,772	37,653	+ 82.6	2.02	1.37	14,492	8,653	+ 67.6
Studebaker	6,564	5,739	3,998	67,835	39,573	+ 37.0	1.99	1.44	12,303	5,966	+106.0
Chrysler	7,512	4,809	3,552	58,698	40,536	+ 45.0	1.72	1.48	12,321	4,680	+163.0
De Soto	5,624	3,541	2,409	45,088	26,952	+ 67.0	1.32	.98	9,165	3,759	+144.0
Nash-La Fayette	5,051	3,351	3,106	43,070	35,184	+ 22.3	1.27	1.28	8,402	5,274	+ 59.3
Hudson	1,913	1,453	2,309	20,825	21,587	− 3.3	.61	.79	3,366	4,168	− 19.2
Graham	1,468	1,070	1,075	16,439	15,965	+ 2.9	.48	.58	2,538	1,832	+ 38.2
Lincoln	2,067	1,696	792	15,567	2,370	+557.0	.46	.09	3,763	972	+287.0
La Salle	3,039	1,433	1,019	13,992	11,775	+ 19.0	.41	.43	4,472	2,192	+104.0
Willys	1,126	556	1,074	12,423	10,439	+ 19.0	.36	.38	1,682	2,211	− 24.0
Cadillac	1,385	968	1,130	11,766	6,692	+ 76.0	.35	.24	2,353	2,185	+ 7.6
Reo	79	125	289	3,146	3,894	− 19.1	.09	.14	204	522	− 60.9
Auburn	52	83	245	1,848	5,163	− 64.2	.05	.19	135	508	− 73.4
Hupmobile	12	10	484	1,556	7,450	− 79.1	.05	.27	22	843	.....
Cord	87	51	.....	1,174	.....	.....	.03	.....	138	.....	.....
Pierce-Arrow	46	54	79	787	875	− 10.0	.02	.03	100	152	− 34.2
Miscellaneous	606	773	33	5,294	1,858	+185.0	.16	.07	1,379	585	+135.0
Total	327,303	223,560	237,194	3,404,497	2,743,908	+ 24.0	100.00	100.00	550,863	457,456	+ 20.5
Chrysler Corp.	83,548	69,581	55,471	851,884	629,243	+ 35.5	25.02	22.93	153,127	104,167	+ 47.0
Ford and Lincoln	65,434	29,390	55,386	764,121	828,889	− 7.8	22.44	30.21	94,824	112,144	− 15.5
General Motors	145,593	98,980	103,448	1,466,852	1,052,297	+ 39.2	43.09	38.35	244,573	200,432	+ 22.0
All Others	32,730	25,609	22,889	321,640	233,479	+ 37.8	9.45	8.51	58,339	40,713	+ 43.1

New Truck Registrations

	December 1936	November 1936	December 1935	Twelve Months 1936	Twelve Months 1935	Per Cent Change, 1936 over 1935	Per Cent of Total Twelve Months 1936	Per Cent of Total Twelve Months 1935
Chevrolet	14,811	10,089	12,475	204,344	167,129	+ 22.1	33.41	32.73
Ford	11,897	5,178	13,764	177,244	185,848	− 4.5	28.98	36.39
Dodge	4,418	5,313	4,634	85,295	61,488	+ 39.7	13.95	12.04
International	5,648	4,881	4,052	71,958	53,471	+ 35.0	11.76	10.47
G. M. C.	1,793	1,284	1,344	26,980	11,442	+135.5	4.41	2.24
Diamond T	765	688	513	3,750	6,454	+ 35.8	1.43	1.26
White	426	542	370	5,757	3,304	+ 74.5	.94	.65
Reo	296	254	551	4,227	5,101	− 17.2	.69	1.00
Mack	431	399	141	4,226	1,515	+189.0	.69	.30
Studebaker	216	205	99	3,279	2,100	+ 56.0	.54	.41
Federal	234	230	203	2,930	2,190	+ 33.9	.48	.43
Willys-Overland	144	163	197	2,441	2,280	+ 7.0	.40	.45
Plymouth	42	40	120	2,420	660	+267.0	.39	.13
Terraplane	169	75	16	1,905	638	+199.0	.31	.12
Indiana	145	115	132	1,705	862	+ 98.0	.28	.17
Brockway	105	134	111	1,695	1,245	+ 36.1	.28	.24
Autocar	165	180	157	1,451	1,001	+ 45.1	.24	.20
Stewart	86	99	99	1,280	880	+ 45.5	.21	.17
Dioco	53	71	86	964	398	+142.0	.16	.08
F. W. D.	50	32	21	369	212	+ 74.0	.06	.04
Sterling	30	37	17	277	174	+ 59.1	.04	.03
Twin-Coach	3	4	6	94	136	− 31.0	.01	.03
Miscellaneous	281	209	150	2,053	2,155	− 4.7	.34	.42
Total	42,208	30,222	39,258	611,644	510,683	+ 20.0	100.00	100.00

Autocar C-O-E Patent

Broad Claims Made on Engine-Under-Seat Design

What appears to be a rather broad patent on motor vehicles of the engine-under-the-seat type has been issued to B. B. Bachman, vice-president in charge of engineering of the Autocar Co. It is entitled "Motor Vehicle" and is U. S. Patent No. 2,064,100, issued Dec. 15, 1936.

The object of the invention is said to be to provide a vehicle of great maneuverability, of greater pay load capacity and with better weight distribution; to provide greater comfort and convenience for the driver, and to make the engine more accessible.

The scope of the patent may be judged from the first of the six claims, which reads as follows:

"A motor vehicle having a cab enclosing a driving compartment, a cowling at the forward end of said cab and in advance of said driving compartment, means associated with said cowling and cooperating therewith to form a chamber insulated from said driving compartment, a radiator mounted within said chamber, a seat-box, an internal combustion engine mounted to locate the upper part of the cylinder block and engine head within the area of the seat-box, the top of the seat box being vertically spaced from the engine head, means for insulating the engine exhaust manifold located within the space between said head and the top of said seat-box, a fan associated with said radiator, means for driving said fan from the front end of said engine, a gear-set behind said engine for transmitting power therefrom, a duct for transferring cool air from said fan to said engine and distributing it thereover, and manually actuatable means in advance of said seat-box for conditioning said gear-set for functioning in transmitting power, as aforesaid."

Canadian Automotive Expansion

Factory modernization and equipment plans in Canadian automobile factories during 1937 call for an expenditure of approximately $8,150,000 according to figures prepared by J. L. Stewart, general manager of the Canadian Automobile Chamber of Commerce. This compares with a corresponding expenditure of over $3,000,000 in 1936. "This survey covers only Canadian plants actually producing automobiles," Mr. Stewart explained, "and does not take into account the similar distribution of large sums for labor, construction materials and equipment by the numerous additional factories which supply the Dominion's automotive industries with parts and materials that go directly into the cars themselves.

West, Meet East!

Here Are the Men Behind Japan's Bid for a Place as an Automotive Manufacturing Nation

6. Viscount Masatoshi Okochi

Viscount Masatoshi Okochi was born in Aichi prefecture in December, 1878. He was graduated in 1903 from the engineering department of Tokyo Imperial University, continuing with his alma mater as an assistant professor and—after further studies in France and Germany—as full professor.

Though the Viscount still holds a post as professor with the university, he is better known in industrial and scientific Japan through his position as director of the famous RIKEN (abbreviation of Rikagaku-Kenyusho), or Physical and Chemical Research Institute. It is a scientific as well as industrial enterprise, the latter activities being known commercially as Scientific Industrial Co., Ltd.

Ever since Viscount Okochi took charge of Riken it has been practically an automotive enterprise. Its automotive research laboratories are among the best equipped in Japan. A metallurgist and engine designer *par excellence*, the Viscount tackles in person the more difficult mechanical problems. Recently he designed a bus engine using natural gas as fuel. Study and design of Diesels is his particular hobby just now.

Best known of the various automotive products manufactured by Riken and marketed by the Scientific Industrial Co., Ltd., are the Riken pistons and piston rings. Put up in attractive packages, they have found their way into almost every country of the world and compete actively in many markets with the products of U. S. parts manufacturers. Riken is at present building in Oji, near Tokyo, a third plant where piston rings exclusively will be made to supply the increasing export demand. During the first six months of last year, the value of piston rings manufactured by Riken reached 1,000,000 yen (approx. $285,000). Profits during this period amounted to 380,000 yen, or 28 per cent of the paid-in capital.

Viscount Masatoshi Okochi

A new Riken aluminum alloy piston has been successfully used in Chevrolet engines, it is claimed, and is to be manufactured soon for use in Ford V-8 engines. The best machine tools made in Japan are said to be those bearing the Riken trade-mark.

Viscount Okochi is rapidly adding a reputation as an industrial reformer to that already established as automotive engineer and manufacturing executive. Admittedly inspired by Henry Ford's ideas, he has launched a nation-wide campaign for what he calls "Building Up Village Industries." His political standing as an influential member of the House of Peers and his ranking among the six leading magazine publicists of his nation have added considerable impetus to his campaign. In his program the automotive industries occupy a prominent place.

Viscount Okochi is already demonstrating his theories with his own enterprises in Niigata prefecture. There, work is brought to the resourceful, industrious Japanese farmers, hard put to make a living from their scanty acres. Japanese leaders look forward to the day when the spare time of millions of peasants will be employed in cutting gears, polishing pistons, stamping body panels, grinding valves and cylinders, etc. When that time comes, Japan will be invincible as automobile manufacturer for the rest of the world, they confidently predict.

(This is the last of a series of six brief biographies of Japanese automotive manufacturing executives.)

New Reo bus is powered by a six-cylinder engine mounted longitudinally back of the rear axle.

Reo Bus Rear-Engined

6-Cyl. Power Plant Is Mounted Longitudinally Behind Rear Axle

Reo Motor Car Co. has announced a new type of bus with the powerplant located at the rear end. The six-cylinder engine is arranged longitudinally in back of the rear axle, the latter being of the so-called De Dion type, and is mounted on a separate tubular carrying member, the differential housing being supported from the frame. The engine, transmission and final-drive gear (of the spiral bevel type) are mounted in line with each other. From the differential gear the power is transmitted to the wheel hubs through shafts with universal and sliding joints. Drums for parking brakes are provided on both sides of the differential housing. The complete powerplant is enclosed in a sealed compartment at the rear and is rendered accessible for inspection and maintenance through a central door at the rear.

This new bus has a wheelbase of 165 in. and a turning radius of 26 ft. The chassis weight is 6000 lb. and the chassis together with a duralumin bus body weighs 10,000 lb. The six-cylinder engine has a displacement of 309 cu. in. and is rated 101 hp. at 2800 r.p.m. It is provided with a 12-in. single-plate clutch and a three-speed bus transmission. Three rear-axle ratios are offered: 4.88 for cross-country service in medium level country; 5.57 for city or slow cross-country service; and 6.5 for city or hilly roads. The front axle is tubular and of the same dimensions as the rear-axle carrying member. Westinghouse air brakes are standard equipment. Tire equipment is 8.25 by 20, dual in rear. The bus seats from 24 to 26 passengers.

Geschelin to Speak at Pittsburgh

How 1937 automobiles are built will be described and pictured by Joseph Geschelin, Detroit technical editor, AUTOMOTIVE INDUSTRIES, at a meeting of the Pittsburgh Section, SAE, Feb. 23. The talk will also touch upon current manufacturing methods and production equipment.

Ask for Uniform Laws

Identical Traffic Rules Urged on Legislators by 14 Groups

Presidents of 14 national organizations totaling more than 10,000,000 members today joined in an appeal to legislators of 24 states urging the enactment of uniform traffic laws with particular emphasis on standard drivers' license laws. The appeal is made to those states which do not have standard traffic laws and whose legislatures are in session.

An open letter to all of the legislators was initiated by John Q. Rhodes, Jr., president of the American Association of Motor Vehicle Administrators and bears the concurring signatures of the presidents or titular heads of the following organizations:

T. H. Cutler, president, American Association of State Highway Officials; Thomas P. Henry, president, American Automobile Association; Harry Colmery, National Commander, American Legion; Thomas Conway, Jr., president, American Transit Association; Alvan Macauley, president, Automobile Manufacturers Association; C. C. Carlton, president, Automotive Parts & Equipment Manufacturers; Roberta Campbell Lawson, president, General Federation of Women's Club; Leon V. Jenkins, president, International Association of Chiefs of Police; E. M. Lied, president, National Automobile Dealers Association; Albert W. Whitney, National Bureau of Casualty and Surety Underwriters; Mrs. B. F. Langworthy, president, National Congress of Parents and Teachers; L. J. Taber, National Master, National Grange, and C. H. Watson, president, National Safety Council.

New Sedan Ambulance Built by Studebaker

Announcement of a new sedan-ambulance was made this week by Paul G. Hoffman, president of the Studebaker Corp. The two-door combination, known as the St. Regis sedan-ambulance, can be converted from sedan to ambulance in 40 seconds. The new dual-purpose Studebaker features a cot in the rear trunk compartment which is instantly available for emergency use. When the cot is in use for ambulance duty, the right front seat is carried in the trunk compartment.

Goodrich Buys Acme Truck Plant at Cadillac, Mich.

The B. F. Goodrich Co., largest Akron supplier of General Motors original equipment tires and the scene of a recent sitdown strike which closed the entire factory and affected 10,000 workers, has made a new move in its decentralization program by acquiring the plant of the Acme Motor Truck Co., at Cadillac, Mich. The building, containing 100,000 sq. ft. of floor space, will be remodeled at once and equipped for manufacture of a general line of mechanical rubber goods, and possibly tires and tubes. Goodrich started production the first of the year in a branch plant at Oaks, Pa., and has substantially increased output in its California factory.

:SLANTS:

PACKARDS TO JAPAN — *The Packard Motor Car Co. has just received orders from the Imperial Household of Japan for 15 Packard super-eights. Eight of the cars are sedan-limousines, five are 5-passenger sedans and two are chassis on which special bodies are to be built.*

All of the cars will be painted a particular shade of red, the official color for all cars of the Japanese Imperial Household. No other automobiles in Japan are permitted to be painted this same color.

TIGER-HUNTING—*Fourteen Chrysler-built automobiles are now on their way to the royal garage of the Maharaja of Indore, fabulously wealthy prince whose word is law to 1,300,000 people of Central India.*

Two of these cars are station wagons and will be used by the youthful ruler to transport the royal tiger-hunting parties and paraphernalia into the jungles near Indore. The engines of all 14 models are equipped with special oil-bath air cleaning screens to protect the cylinders from sand and dust during the dry season.

W. B. MAYO, formerly chief engineer of the Ford Motor Co., has been elected chairman of the board of the Huron River Silica Co. This is Mr. Mayo's second venture in the glass industry, the first being his invention of the continuous process for the manufacture of plate glass now used by the Ford Motor Co. and others.

J. WALTER DRAKE, original organizer of the Hupp Motor Co., has recently been named president of the Huron River Silica Co.

ARCHIE T. COLWELL, director of engineering for Thompson Products, Inc., since 1930, has been made vice-president of the company in charge of engineering. Mr. Colwell is prominent in SAE circles. He was chairman of the Cleveland Section last year, and is a member of the national council.

HOWARD R. WEISBERGER has resigned from the Chevrolet Motor Co. and moved to Los Angeles where he expects to open an office of industrial engineering.

Baker Makes Economy Record With Graham Supercharger

Driving a stock Graham Supercharger sedan—a duplicate of the car which won the Gilmore-Yosemite Economy Run Sweepstakes Award twice in succession, "Cannonball" Baker last week set a new economy record of 26.08 mi. per gal. for the 132.5 mi. from Cleveland to Lorain, Sandusky and return. Operating under severe winter road conditions the car rolled up a score of 58.33 ton-mi. under the sanction of officials of the Cleveland Automobile Club.

Chrysler Earnings at Record High

Net Income of $62,110,542 or $14.25 a Share Reported for 1936; Sales Totaled $667,138,391

Chrysler Corp. reported record net earnings for 1936 of $62,110,542 or $14.25 a share, the result of the largest sales in its history. Directors declared a dividend of $1.50 a share, which compared with $5.50 and $4 declared at the two previous meetings. Total dividends paid in 1936 were $12 a share.

The reported net income compared with $34,975,819 or $8.07 a share in 1935. Based on a comparison of the nine months' and the year's statements, results for the final quarter of the year were $20,135,216 or $4.62 a share compared with $11,791,361 or $2.72 a share for the fourth quarter of 1935.

Sales for the year were $667,138,391 against $516,830,333 for the preceding year. Unit sales were 1,066,229 vehicles. Sales for the final quarter were 297,726. Unit sales in 1935 were 843,599 cars and trucks and fourth quarter sales, 244,184 units.

The income statement showed depreciation and amortization charged to cost of sales at $14,211,151 compared with $16,986,563 for 1935. Plants and properties were carried at the net

Acme photo

Greatest gathering of trailer tourists in the world is now in session at Sarasota, Fla. More than 1400 trailers, housing 3500 persons, are parked in the municipally operated camp shown here.

amount of $60,229,754 against $53,577,484 a year ago.

A consolidated balance sheet as of Dec. 31, 1936, shows the following major items with comparisons:

	1936	1935
Cash	$46,551,620	$57,428,625
Mark. securs. cost	14,352,803	1,688,961
Car shipts. B/L	10,460,516	9,326,360
Receivables	8,171,299	10,994,858
Inventories	60,565,446	48,765,678
Curr. assets	140,101,687	128,204,484
Curr. liabs.	75,131,875	66,901,392
Other assets	8,216,780	8,246,880
Net prop'ty	60,229,754	53,577,484
Reserves*	12,224,833	9,616,449
Cap. surp.	25,995,627	24,719,019
Earned surp.	75,531,892	65,612,041

*Excludes estimated tax reserve in current liabilities of $14,000,000.

Morse Chain to Market Hydraulic Valve Tappet

The Morse Chain Co., Detroit, will place on the market very soon a unique valve tappet which is essentially a self-contained hydraulic unit capable of automatic tappet clearance adjustments. Among the features claimed for this unit are: zero tappet clearance with consequent silent valve action, longer life for the valves, better idling, and less valve overlap. The interesting feature of this unit is the fact that it may be designed to interchange with standard valve tappets and consequently can be used both as standard equipment and for replacement.

Ford's Singer Is Unsung Engineer

Richard Bonelli Dropped Monkeywrenches for Music And Has Always Been Sorry Since . . . Maybe

Guest star on the Ford Sunday Evening Radio Hour of Feb. 7 was Richard Bonelli, leading baritone of the Metropolitan Opera Co. Possibly 15 minutes of that evening he gave, viva voce, to the automobile industry. Few people in the industry realize that most of his spare time has been "given" to the industry too. Here is the story of the Bonelli nobody knows . . . written especially for automobile engineers and executives.

By H. E. Blank, Jr.

Among the stars of the Metropolitan Opera there is a man who could make just claim to genuine engineering ability, and who can say, "I am frequently referred to as an engineer, but that is not so. True, I am deeply interested in things mechanical, particularly automobiles. However, while I devote much of my spare time to keeping in close touch with the latest technical developments, I am honestly very much the amateur." The man is Richard Bonelli, distinguished baritone of the Metropolitan. And despite this refreshingly frank confession, he is surprisingly well-informed on "things mechanical, particularly automobiles."

Bonelli's interest in automotive vehicles dates from his youth. While attending high school in Syracuse, he offered his spare time to a garageman for nothing, "just to get the opportunity to tear them apart and put them together." He had a swell time on the job, servicing cars until, as he tells the story, "some —— stole my overalls. I couldn't afford another pair and that ended the fun."

The mechanically minded opera star was born into a musical family in Port Byron, N. Y. He grew up with a love for music, but never intended to enter the field professionally. Instead, it was his intention to become an automobile engineer and with this purpose in mind, he entered Syracuse University as a mechanical engineering student. He was diverted from this future by a Syracuse professor who heard him sing and convinced the young man that he should make music his career. He has achieved remarkable success as a singer, but still finds time to follow his first interest.

Mr. Bonelli, though quite amenable to progressive changes in design, objects to some of the present adaptations of streamlining to automobiles. "Rounded corners and the attempt to achieve a pleasing exterior appearance have resulted in impairment of driver vision." However, the word streamlining suggested the new trains operating in the West. "I made a beeline to ride on the first one placed in operation. Now I've ridden on practically every one in the United States. One time I made the trip in the cab of a Diesel-powered locomotive." Hand clapped to forehead, in a quick gesture of memory searching, Mr. Bonelli proceeded to reel off the horsepower of the power units now in use on the various railroad lines.

Not in any sense a hypercritical person, Bonelli has been, on occasions, quite put out by the sad lack of technical information exhibited by automobile salesmen. The interviewer suggested, as a faint challenge, that the business of these men is to sell cars and to do this here in America it is not necessary to have much familiarity with the engineering features of the vehicle. Mr. Bonelli made vehement reply. "I disagree with that attitude. These men should have a thorough and accurate knowledge of the product they are selling. And this not only holds true for the men who sell cars, but for the people who drive. Every driver should know something about the machine he operates so that he can drive safely and intelligently."

He likes to devise new gadgets that would add to driver comfort and safety. For instance, several times while driving, he has been stung by insects that flew into the car. "I decided to arrange some means of protection. I was getting sick of being stung by bees." As partial answer to the problem, he made a wire screen to fit the cowl of his car. On one of his frequent visits to the plant of a prominent automobile manufacturer there was considerable interest shown in his "bee trap." To the plant engineers, Mr. Bonelli enthusiastically pointed out the public appeal of such a device. They were interested and the idea was incorporated into some of their new models. "Of course," said Mr. Bonelli, "the idea should be carried further. It would be a fine thing if roller screens were supplied for each window of a sedan."

He has an unlimited number of suggestions for improvements in the modern automobile. "Sedan models should have openings in the top. I think we shall eventually come to that. Aside from making possible to sedan owners the pleasures of an open car, with top down, it would be a real boon to travelers—permitting them to see more of the scenery as they ride along." And this resourceful artist would like to see rear windows on sedan models so made that they could be opened. Another suggestion, which he referred to as the invention of a friend, would appeal to those who have trouble in keeping a high hat on their heads when driving in the new models. "As you open the door of the car, a sort of trap door in the roof of the car slides back." There was a noticeable twinkle in the eyes of the interviewee as he broached this contribution to modern car design. And the interviewer had disturbing surrealist visions of cars purring along with shiny, black stovepipes jutting from the roofs.

Bonelli at Bench

Stung by bees, he objected . . . persuaded Pierce-Arrow to install screens

Business in Brief

Written by the Guaranty Trust Co., New York, exclusively for AUTOMOTIVE INDUSTRIES

General business activity was retarded temporarily last week by the floods in the Ohio and Mississippi Valleys. The weekly index of business activity, compiled by the "Journal of Commerce," stood at 92.5, as compared with 96.6 the week before and 77.0 a year ago. Retail trade was estimated from 10 to 15 per cent above that a year ago, while wholesale business registered gains from 18 to 22 per cent.

Carloadings Decline

Railway freight loadings during the week ended Jan. 30 amounted to 659,790 cars, which marks a decline of 10,586 cars below those in the preceding week, a gain of 37,900 cars above those a year ago, and a rise of 62,829 cars above those two years ago.

Food Costs Rising

According to the Bureau of Labor Statistics, retail food cost rose 2.1 per cent between Dec. 15 and Jan. 12. Seventy-two of the 84 foods included in the Bureau's index advanced in price. The current index is 3.6 per cent above that in the corresponding period last year.

Power Output Gains

Production of electricity by the electric light and power industry in the United States during the week ended Jan. 30 was 13.3 per cent above that in the corresponding period last year.

Living Costs Steady

The cost of living of wage earners remained unchanged from Sept. 15 to Dec. 15, according to the Bureau of Labor Statistics. Lower food costs at the end of this quarterly period were offset by increases in all of the other groups included in the index.

Crude Output Steady

Average daily crude oil production for the week ended Jan. 30 amounted to 3,194,050 bbl., as against 3,205,150 bbl. the week before and 2,815,550 bbl. for the corresponding period last year.

Fisher's Index

Professor Fisher's index of wholesale commodity prices for the week ended Feb. 6 stood at 90.4 as against 90.4 the week before and 90.2 two weeks before.

Federal Reserve Statement

The consolidated statement of the Federal Reserve banks for the week ended Feb. 3 showed no changes in holdings of discounted bills, bills bought in the open market, and government securities. Money in circulation increased $30,000,000, and the monetary gold stock rose $19,000,000.

All-Steel Body Patent

French Inventor Makes Broad Claims on Frameless Construction

We have been informed by our Paris correspondent, W. F. Bradley, that a French inventor, Emile Claveau, claims a basic patent on the modern frameless, all-steel type of automobile with integral floor and roof. Mr. Claveau's U. S. patent is No. 1,674,425, entitled "Construction of Closed Motor Vehicles," and was issued June 19, 1928, on an application filed Dec. 22, 1923. The specification outlines the objects of the invention in the following terms:

"Closed motor vehicles as at present constructed are formed of an ordinary chassis, usually deformable, upon which rigid coachwork is placed; such vehicles have the disadvantage of being very heavy, while the coachwork rapidly develops play and soon becomes noisy; moreover, its construction results in the vehicle offering a great resistance to forward movement, so requiring a high horse power to overcome the weight and resistance of the air. They are also costly.

"According to this invention these defects are removed by a system of construction which has the following advantages:

"(1) Simplicity, lightness and economy of construction.

"(2) Relatively small resistance to forward movement, owing both to the shape of the vehicle which takes into account aerodynamic laws utilized in aviation and aerostation apparatus, and to elimination of all parts and accessories outside the vehicle.

"(3) Perfect accessibility of all parts.

"(4) Protection of all parts against mud and dust.

"(5) Reduction to a minimum of weight not suspended and better distribution of weight suspended which is arranged between the front and rear points of suspension and better bite on the road due to the lowering of the center of gravity."

The single claim of the patent reads as follows:

"In a motor vehicle, a fish-shaped framework comprising upper and lower longitudinal frames, each of said frames converging adjacent the forward and rearward ends thereof and having portions secured together adjacent their forward ends, and cross frame members and vertical frame members connecting intermediate portions of said frames."

Archie T. Colwell, named vice-president in charge of engineering of Thompson Products, Inc.

Defiance Pressed Steel In New Plant at Merion

After an interruption of seven months, the Defiance Pressed Steel Co. has resumed operations in its new plant at Marion, Ohio, according to an announcement by E. L. Herbolsheimer, president. The company's 66-year record of continuous operation was broken last June when fire destroyed the plant at Defiance, Ohio. Following the fire, the buildings formerly occupied by the Power Mfg. Co., of Marion, were taken over and renovizing started at once.

40 Years Ago

with the ancestors of AUTOMOTIVE INDUSTRIES

Wheel Diameters

In considering the diameter of the wheel that should be employed on a motor vehicle it is well to remember that we employ large wheels now because the horse's breast, from which he draws the load, is high, and because a large wheel gives a longer leverage in lifting the load over obstructions. But the pneumatic tire accomplishes this better than the large wheel, and roads are fast being improved all over the world. Then again, while the horse is capable of a strong, sudden pull, he is unequal to the continued effort of the motor.

All these reflections, without taking into account the question of gravity, point to a smaller wheel as more desirable for the motor vehicle.

—From *The Horseless Age*, February, 1897.

Automotive Metal Markets

Fear That Lewis' Next Attack May Tie Up Steel Industry Leads to Heavy Stocking by Consumers

By William Crawford Hirsch

Uncertainty as to the extent to which second quarter steel mill operations may be affected by labor troubles is becoming more and more of a market factor. The Steel Workers' Organizing Committee has now been at it seven months and claims to have formed "lodges" at more than 200 mills with April 1 set by John L. Lewis as the zero hour for the steel industry to jump through the hoop.

While the lifting of suspensions by General Motors on some shipments previously under "hold" orders contributed to the movement of steel to consumers in the last few days, a more widespread disposition to build up reserves is also in evidence. There are physical difficulties in the way of stocking some descriptions of finished steel, but in a good many cases consumers, who feel more secure with as large material reserves as possible in their own warehouses, manage to add to these in one way or another and in the aggregate this reserve tonnage is somewhat larger than a mere nest-egg.

By no means, however, can this buying be characterized as speculative; in fact, developments in the last few weeks have diverted attention from price. There still remains a heavy tonnage of flat steel to be delivered to automotive consumers at the lower prices in vogue before the recent advance, but by the side of this business production is being rushed on considerable tonnage that has been booked at the higher levels. Strip mills, because of their speedier production, have not as large a backlog as sheet mills, but at that most of them are booked to virtually capacity over the remainder of the quarter. Carbon and alloy steel bar mills, in addition to a good-sized backlog of General Motors business under temporary suspension, have booked considerable new tonnage at the higher, first quarter price levels. All in all, steel mills are pushing output all they possibly can and automotive consumers are taking every ton of steel they can possibly take in.

Pig Iron—Blast furnace interests are well pleased with the volume of business coming onto the market, although for the most part this is of the single carload type. Most of the pig iron producers needed a breathing spell to be able to catch up with the demand and to make ready for the more active shipping season. Prices are unchanged and firm.

Aluminum—The sole domestic producer of primary aluminum is reported to be preparing for an increase in the output of his Tennessee work, a judicial decision facilitating the supply of the required electric power being of great help in this. The market is unchanged, with the undertone of that for secondary metal a shade firmer.

Copper—With the foreign markets ruling approximately ¼ of a cent above the price of copper here, a "protective" advance on this side was looked for from the opening of this week's trading. In fact, it was said that business at 13¼ cents, a rise of ¼ cent over the previous quotation, could have been done early this week, had producers been willing to sell. Meanwhile the price of scrap copper and brass jumped $4 to $5 a ton and advances in automotive brasses, and other finished products were momentarily expected.

Tin—Paucity in the demand since the General Motors strike is having a sobering effect on the "bull" speculators in London. Spot Straits tin was quoted at 50⅜ cents at the week's opening.

Lead—Storage battery manufacturers showed more interest in the market, which was unchanged, but a shade firmer.

Zinc—A $3 per ton rise in zinc prices on Monday was ascribed to the market's sold out condition.

The Ross Operating Valve Co., Detroit, has issued a new catalog which contains complete information on its line of **operating valves** for the control of single and double acting air cylinders.*

A catalog recently made available by the Pheoll Mfg. Co., Chicago, in addition to price lists covering the complete line of **threaded products** made by this company, contains American standard screw thread specifications, dimension tables, weight tables and other useful data.*

A new edition of the booklet Standard **Sling Chain Specifications** has been issued byAmerican Chain Division of American Chain and Cable Co., Inc., Bridgeport, Conn.*

The Van Keuren Co., Watertown, Mass., has issued circular G32 entitled "Measure **Spur Gears** with Precision Wire."*

"A Manual of **Factory Lighting Practice**" has recently been published by the Benjamin Electric Mfg. Co., Des Plaines, Ill.*

A new edition of the book **"Grinding Wheel Specifications** for Grinding Machines" has been brought out by the Norton Co., Worcester, Mass.*

Kane & Roach, Inc., Syracuse, N. Y., has brought out a booklet announcing its 50th anniversary.

United States Rubber Products, Inc., has prepared a new catalog which covers its complete 1937 line of **rubber hose.***

*Obtainable from editorial department, AUTOMOTIVE INDUSTRIES. Address Chestnut and 56th Sts., Philadelphia.

To Celebrate Studebaker Birthday

Business and civic leaders of South Bend are to join Feb. 15 in honoring the Studebaker Corp. on its eighty-fifth birthday anniversary. Plans for the fete are being worked out by the South Bend Association of Commerce.

Calendar of Coming Events

SHOWS

Automobile Show, Berlin, Germany, Feb. 20-March 7
Hungary, International Automobile, Motorcycle and Motor boat Exposition, Budapest .....March
Austria, Automobile and Motorcycle Salon, Vienna .....March 7-13
Switzerland, 14th International Exposition, Automobiles, Motorcycles and Bicycles, Geneva .....March 12-21
Portugal, 11th Automobile Salon, Porto March 27-April 5
Illinois Automotive Ass'n, 4th Annual Show and Maintenance Exhibit, Navy Pier, Chicago .....Apr. 24-28
Poland, Automobile Salon—16th International Fair, Poznan .....May 1-10
Norway, Automobile Salon—Oslo..May 7-10
Second Annual Automotive Maintenance Show, San Francisco..May 20-23
Belgium, First International Aeronautical Salon, Brussels ....June 18-30
Fourth ASTM Exhibit of Testing Apparatus and Related Equipment, New York .....June 28-July 2
Poland, Automobile Salon (Foire Orientale), Lwow .....Sept. 1-15
France, 31st International Automobile Salon, Paris .....Oct. 1-17
Great Britain, 31st International Automobile Exposition, London..Oct. 14-23
National Automobile Show, New York, Oct. 27-Nov. 3
Italy, 10th International Automobile Salon, Milan .....Oct. 28-Nov. 8
Great Britain, 13th International Commercial Automobile Exposition (trucks and buses), London..Nov. 4-13
Chicago Automobile Show.....Nov. 6-13
Great Britain, 36th Scottish International Automobile Exposition, Glasgow .....Nov. 12-20

CONVENTIONS AND MEETINGS

Association of Highway Officials of No. Atlantic States, 13th Annual Convention, New York .....Feb. 24-26
American Society for Testing Materials, 1937 Regional Meeting and Committee Week, Palmer House, Chicago, March 1-5
Sixth Annual Welding Conference and Exposition, Ohio State University, Columbus, Ohio .....March 3-5
S.A.E. National Aeronautical Meeting, Washington, D. C. .....March 11-12
S.A.E. Regional Transportation and Maintenance Public Utility Meeting, Baltimore, Md. .....April 15-16
International Association for Testing Materials, Second International Congress, London, England.April 19-24
SAE National Tractor and Industrial Power Meeting, Peoria, Ill..April 21-23
41st Annual Convention and Exposition of the American Foundrymen's Association, Milwaukee .....May 3-7
S.A.E. Summer Meeting, White Sulphur Springs, W. Va. .....May 4-9
American Society of Mechanical Engineers, spring convention, Detroit, May 17-21
American Petroleum Institute, Mid-Year Meeting, Colorado Springs, Colo. .....June 1-3
Second World Petroleum Congress, Paris, France ....late May—early June
Automotive Engine Rebuilders Association, 15th Annual Convention, Chicago .....June 21-24
American Society for Testing Materials, 40th Annual Meeting, New York, June 28-July 2
S.A.E. National Aircraft Production Meeting, Los Angeles, Calif....Oct. 7-9
S.A.E. Annual Dinner, Commodore Hotel, New York .....Oct. 28

CONTESTS

Indianapolis Speedway, 500-Mile International Sweepstakes .....May 31
Pan American Cup Race, Roosevelt Raceway .....July 5
Roosevelt Raceway, 400-Mile George Vanderbilt Cup Sweepstakes....Sept. 6
Los Angeles, 500-Mile International Sweepstakes .....Nov. 28

Capacity Output Ahead

(Continued from page 207)

the close of the model season. This is the usual pattern, but it undoubtedly has been upset this year by the strike and peak stocks will not be reached until well into March or even later.

Stocks of GM vehicles were reduced by 22,097 units last month, which nearly wiped out the increase of 23,595 made in December. At the end of January overall stocks of the corporation were only 27,045 units higher than at the end of September which was the close of the 1936 selling season and dealer inventories were at the year's low.

Despite a record December production, stocks of all passenger cars in the industry at the start of the year were about 20 per cent under the level of a year ago and were equivalent to about three weeks' supply on the basis of the December rate of sales. At the start of the selling season, the lower priced popular makes normally have about six weeks' supply on hand while other higher priced cars range up to eight weeks' supply or more.

With the Automobile Manufacturers Association reporting a January output of 269,839 by members, a closer estimate can now be made of the industry's total which appears to have reached at least 410,000 cars and trucks, of which GM accounted for roughly 22 per cent. The new estimate for the industry compares with 519,132 vehicles built in December and 377,306 in January last year.

Studebaker sales in January exceeded every other January in Studebaker history with one exception, according to Paul G. Hoffman, president. Sales of 7735 passenger cars and trucks are reported, compared with 6036 in January of 1936—an increase of 28 per cent. The only other year in which January sales were greater was 1923.

Orders for new trucks, buses and fire fighting apparatus booked by Mack Trucks, Inc., during 1936 were more than 100 per cent greater in units than in 1935, while the dollar volume of new business showed an increase of approximately 50 per cent. The company entered 1937 with about $5,500,000 of unfilled orders on hand and last month booked about $4,000,000 of additional business which represents a volume substantially greater than in the corresponding month of 1936.

Court Sustains Stay in GM Case Against NLRB

The Circuit Court of Appeals for the Eighth Circuit has turned down a petition of the National Labor Relations Board to vacate a stay, effective last July, to prevent the board from investigating alleged unfair practices in the Fisher body and Chevrolet assembly plants of the General Motors Corp. at St. Louis. The board recently petitioned the court to vacate the stay.

Refusal of the court to grant the petition means that the board can take no action in the dispute between the company and its 3900 workers in the St. Louis plant. The stay was granted upon petition of the General Motors Corp., and deprives the board of power to hold hearings in General Motors cases in States where the stay is operative. Hence the board is enjoined from conducting a company-wide inquiry into the matter of labor relations or conducting a company-wide election to determine employe representation.

Chrysler Wages Lifted

(Continued from page 207)

of hourly workers were increased 20 per cent. A further increase of 10 per cent was granted in March, 1934, which, according to K. T. Keller, president, placed the wage rate somewhat above the pre-depression level.

Shop employes were granted another 5 per cent increase last June 1, which cost the company an estimated $5,000,000 to $6,000,000. A revision of the wage system from piece work and group bonuses to hourly rates, begun in March, 1934, and completed in April, 1935, also brought additional compensation to most of the employes. At that time, according to company officials, the minimum rate for men, excepting apprentices, was 60 cents an hour, and for women, 52 cents an hour.

Commenting on the Chrysler increases, John L. Lovett, manager of the Michigan Manufacturers Association, said:

"While I do not know of any general increase now contemplated by any other manufacturer, yet there is a tendency to approach an average minimum of 75 cents an hour for men and 65 cents for women employes among Detroit manufacturers generally. I believe the Chrysler Corp.'s wage increase is based on this general average.

"It is believed this tendency is justified by the increased cost of living and in view of the fact of Detroit's reputation for paying the highest wages of any manufacturing district in the country."

Plymouth Com'l Cars

High Compression Engine, Truck Chassis Feature Models

A line of Plymouth commercial cars has been announced by the Plymouth division of the Chrysler Corp. All models are mounted on a special commercial chassis of 116-in. wheelbase. The new Plymouth commercial pick-up and commercial sedan are already in production and samples have been shipped to dealers in many parts of the country.

The chassis includes a special truck-type frame with 6-in. side channels and five cross members to give extra strength. The engine is of Plymouth L-head design with a compression ratio of 6.7 to 1. Universal joints have roller bearings and the heavy duty transmission has five ball and roller bearings. The rear axle is of the hypoid type. Plymouth hydraulic brakes are used.

Both cabs and bodies of the new commercial line are of all-steel construction. The load compartment in the commercial sedan is 78 in. long at the floor and 55⅞ in. wide at the belt. The pick-up box is 6 ft. long with a floor width of 47½ in.

Dr. Barnard to Address Detroit SAE

Dr. H. E. Barnard, director of the Farm Chemurgic Council, Dearborn, Mich., will address the Detroit Section, SAE, at the meeting to be held Tuesday, Feb. 16. Doctor Barnard will cover in detail some of the latest developments in the current work dealing with the utilization of farm products in industry.

Sharp Decline in GM's Jan. Sales

Strike Reduced Total Shipments for Month to 103,668; Dealer Stocks Low

Effects of the strike which began closing General Motors assembly plants at the beginning of the year are shown in the corporation's January sales report. January sales to dealers in the United States and Canada, together with shipments overseas, fell to a total of 103,668 units compared with 158,572 in January, 1936, and 239,114 in last December.

Sales of General Motors cars to consumers in the U. S. totaled 92,998 in January compared with 102,034 in January a year ago. Sales in December were 173,472. Sales of General Motors cars to dealers in the United States totaled 70,901 in January compared with 131,134 in the same month last year, and 197,065 last December.

The accompanying table gives further details of General Motors sales:

	Jan., 1937	Dec., 1936	Jan., 1936	3 Months Ending January, 1937	3 Months Ending January, 1936
Sales to world dealers	103,668	239,114	158,572	534,502	527,024
Sales to U. S. dealers	70,901	197,065	131,134	424,007	428,993
Sales to U. S. consumers	92,998	173,472	102,034	422,022	361,091
Change in U. S. dealer stocks	—22,097	+23,593	+29,100	+1,985	+67,902
Sales to foreign dealers	32,767	42,049	27,438	110,495	98,031

Just Among Ourselves

So What?

SO far as the public is concerned, the General Motors strike is settled. It won't be front-page stuff much longer, unless some unexpected development should precipitate a fresh climax. In this fact lies a grave danger that the issues for which no solution has been found will sink into obscurity, with the gradual diminution of the social tensions which have characterized the forty-three days of the fiasco at Flint.

For we believe, on the strength of the data at hand, that truce, not settlement is overwhelmingly the tag which must be applied to the General Motors case, as well as to the glass strike and certain disturbances which took place in South Bend, Indiana, last spring.

Four major industrial crises (we include those in Akron) have brought to no conclusion the legal status of the sit-down strike. Judge Gadola ruled that it was trespass and issued writs requiring General Motors workers to vacate GM plants. But that was a chessboard or moral victory; there was once a Chinese general who was captured in his tent at the moment he was demonstrating on his chessboard that one more move would put his enemies to flight.

In the present truce General Motors agrees, subject to court sanction, to withdraw applications for writs and injunction pending against the UAW as a result of the sit-down strikes. In its court proceedings, General Motors won a moral victory of definite character, but in the text of the agreement we are very much afraid that Mr. Lewis will appear to his followers and to the public to have established a moral victory of indefinite but tremendous import.

It would be fictitious, we believe, to claim a complete victory for either side in the present controversy. Fifteen days of negotiations will push the balance a little farther to one side or the other. Meanwhile, like the fictions in the calculus, Mr. Lewis's infinitesimal gains may be built up in the minds of labor to the status of a proper basis for a whole system.—H. H.

Photomontage by Howard Kohlbrenner

To arrive at any worthwhile appraisal of the contribution to society made by farm mechanization, a picture of conditions as they existed before its advent is necessary.

Farm Mechanization Has Changed the Life of the Entire World

*By Harry G. Davis**

IMPORTANT technological changes in any basic industry frequently set in motion certain processes of evolution, the effects of which cannot be recognized for a long time and, usually, when they are detected, they have become so commonplace that it is almost impossible to appraise their real value. This has been true of "The Cavalcade of Farm Mechanization."

When Cyrus Hall McCormick brought out the reaper a little more than a century ago, he set in motion a process which ultimately was to change the economy of the entire world as well as the sociological destiny of millions unborn. It is doubtful if he had any definite conception of the far-reaching effect of his invention and it is quite certain that none of that little group of interested spectators who assembled at the McCormick farm, near Steele's Tavern, Virginia, on that hot day in July, 1831, to see the first test of a machine which would reap standing grain, dreamed that they were witnessing the birth of a new era in world civilization.

Now that a century has elapsed since that epochal day and mechanization of agriculture has proceeded to the extent that practically every farm job can be done by a machine, we find that mechanization has become so commonplace that it is almost impossible for us to appraise the real value of the contribution it has made to society. As a matter of fact, we have among us some who question whether mechanization actually has benefitted society. We all are familiar with the theory of technocracy.

Trouble lies in the fact that people of this generation have become so accustomed to our mechanized way of doing things that they are unable to conceive what conditions actually existed before the advent of the machine. Without a mental picture of life in the pre-mechanized era, they are unable to contrast present conditions with those of the old hand method period. They merely accept mechanization as a matter of fact and never stop to think that most of the things they hold near and dear are, in reality, the fruits of it.

In our own country in 1820 it required 83.1 per cent of all gainfully employed workers to operate our farms and only 16.9 per cent were employed in all other occupations, including the arts, sciences and professions. In 1900, it required only 35.5 per cent of all gainfully employed workers to operate our agriculture and 64.3 per cent of the others were free to find occupations in other industries, the arts, sciences and professions.

How has the farmer fared in the "age of mechanical power"? In field operations, horses and mules have been replaced by tractors and larger sized machines, running at higher speeds, enabling a farmer to do more and better work in a given time than could have been done with six or eight horses and by two or three men in the animal power age, a third of a century ago.

In small grain growing, seedbed preparation, seeding and harrowing are done in a single operation, and again the combined job of reaping and threshing. Multiple row machines speed up the work of growing corn and the crop is harvested with a mechanical picker. Silo fillers and feed grinders save much of the nutritive parts of crops which formerly went to waste. A motor truck does the hauling, both about the farm and to market.

With the extra speed and capacity of motorized equipment, the farmer has more time to devote to other branches of his enterprise and to self-improvement and recreation. Blooded cattle graze his pastures and pure-bred swine fatten in his pens. Even his chickens and his turkeys can boast of lineages as proud as that of anybody's family tree.

His house is a veritable palace in comparison with that seen in the first picture. It is furnace-heated, lighted by electricity and furnished in the up-to-date style of a modern city home. There is running water in the kitchen and bathroom. A radio brings news,

In 1830 all but 16.9 per cent of all gainfully employed persons in the United States were occupied with farming. With the development of labor saving methods the percentage of those employed at other than farm occupations rose to 64.3 per cent in 1900 and 78.5 per cent in 1930. Such is the contribution of farm mechanization to the arts, sciences and industries that have developed a fuller civilization.

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market reports, lectures and entertainment from distant points. The rural mail carrier makes daily deliveries. A telephone gives instant communication with neighbors and with all parts of the country. A motor car is always ready for journeys near and far over paved roads which stretch from farm to town and all parts of the land. Distances have been wiped out and isolation, so irksome to farm people a generation ago, no longer exists.

The farm wife, too, enjoys the benefits of mechanization. There are no hired men or hungry threshing crews to feed. An electric refrigerator preserves her food and affords cool water. She mixes her bread with an electric mixer; bakes it in an electric oven; washes her clothes with an electric washer; irons them in an electric mangle; cleans her house with a vacuum cleaner, and toasts her bread in an electric toaster. In her everyday life, she has more comforts and conveniences in her home than her most prosperous city sister could have had at the close of the Nineteenth Century.

Freedom, too, has come for the children. No longer is it necessary to keep them out of school to work about the farm. Every morning, except Saturday and Sunday, they board the school motor bus that stops at their door to attend the consolidated school where modern educational equipment has displaced the ragged dictionary, the cracked globe and the torn atlas that comprised the teaching paraphernalia of the little "old red school house." From the consolidated school, they go to high school and from there on to college or university to fit themselves for professional careers or other useful service.

In our own country in 1930, as a result of this advance in mechanization, only 21.5 per cent of our gainfully employed were required to operate our farms and 78.5 per cent were engaged in other occupations, arts, sciences and professions.

While all these wonderful changes were taking place on the farm during the transition from human to animal and from animal to mechanical power, great forward strides were being made in all other lines of human endeavor. Railroads were being built; mines were being opened and developed; the prairie sod was being turned; giant industries were being established, and the mysteries of chemistry and nature were being established, and the services of mankind. The country, itself, was growing from a narrow strip of land along the Atlantic Seaboard, with less than 10 million inhabitants, to a mighty empire that stretches from ocean to ocean and from the Great Lakes to the Gulf of Mexico, with a population of more than 127 million people.

How could all this be accomplished in such a short space of time? The answer is plain. It was the natural result of agricultural mechanization.

In the age of human power in agriculture, the productive capacity of the individual farm worker was so small that more than one person out of five of the total population, including women and children, were engaged in agriculture. When such conditions prevailed, there was little time or opportunity to engage in other undertakings because the vitally essential thing was to insure the people with a supply of food and clothing material. When the machine came, however, and the productive capacity of the individual farm worker was increased to the degree that he was able to produce enough for himself and a surplus to send to market, those who were no longer compelled to serve as agricultural workers could then find new occupations, create new industries or apply themselves to the development of the arts, sciences and professions. As the process of farm mechanization proceeded, more and more men were freed from agricultural pursuits and more and more of them found employment in new industries. That they did this, and made a good job of it, is vividly demonstrated by the history of America, for our own national development has gone hand in hand with the process of our agricultural mechanization. Today only one person out of 12, including women and children, is engaged in agriculture as compared to one out of five in the pre-mechanization era.

Larger Earnings

While farm machinery has wrought most wonderful changes in agriculture, itself, its effect upon general welfare is still greater, because its influence extends to every branch of our national economy. It is impossible for anyone to be so far removed from the farm as to be free from the effect of agricultural mechanization. If every farm machine was put out of existence today, and we were compelled to turn back to conditions as they existed in 1820 when it required 215 agricultural workers per thousand population, seventeen million people would have to give up their present occupations, grab spades and hoes and start to grow their own food and clothing material. If this transition resulted in employment of only 43 persons per thousand population in all non-agricultural occupations, as was the case in 1820, seventeen million more would have to give up their jobs and join the vast army of permanently unemployed.

Consider the possible elimination of one machine, the cotton gin, for instance. If we were to do away with this machine and did not reduce our production below the average of the past 10 years, it would require more than 30 million people, working eight hours per day for 300 days per year to separate by hand the seed from the cotton lint.

But there is another aspect of mechanization which must not be overlooked, and that is its effect upon the earning capacity of those engaged in other occupations. In 1840, when we were still in the age of human power in agriculture, average hourly earnings of wage earners, exclusive of those engaged in agriculture, were 7.9 cents per hour. In 1900, just before the dawn of the age of mechanical power, average hourly earnings were 17.5 cents. In 1934, when in the neighborhood of 30 per cent of our farms of 50 acres and over were using tractors, average hourly earnings of wage earners outside of agriculture were approximately 48 cents. It was these marvelous increases in earning rates in non-agricultural industries, due largely to mechanization, that created the purchasing power which makes a market for both agricultural and non-agricultural products and provides employment for millions of people in our varied industries and professions.

Steam was not to solve the problem of supplying mechanical power to agriculture. It remained for Otto, a German inventor, to discover the principles of the internal combustion engine which he patented in 1876, to point the way to real agricultural mechanization. His engine, the prototype of the modern tractor and automobile engine, and not Watt's steam engine, was destined to be the basis of future developments in the tractor and automotive industries. Cyrus McCormick, in his book, "The Century of the Reaper," paid to the German inventor, Otto, a well merited tribute when he wrote:

"Otto's name may, if you will, be added to those of Whitney and McCormick to make up the trio whose practical researches have for all time been of the greatest benefit to farmers."

The most noteworthy of the early farm tractors was the one powered by an internal combustion engine, built in the winter of 1901 and sold the following summer to an Iowa farmer. The next year its builders, C. W. Hart and C. H. Parr, of Charles City, Iowa, built 15 tractors, and thus a new industry was born. The history of the industry in those early years reads like a counterpart of the history of the

automobile industry. Tractor factories sprang up all over the land, some of them little more than mere machine shops and some probably little more than promotional projects. I have a list of 503 companies who were said to be in the tractor manufacturing business in 1915. Today, less than 25 survive.

It is doubtful if any infant industry ever faced more difficult problems to solve than did this one. The tractor started out to be a substitute for the horse and one manufacturer actually adopted the trade name of "Iron Horse" for his machine. Naturally, early models were crude and inefficient and greatly limited in the scope of their operations when compared to modern day standards. They were capable of delivering only belt and drawbar power and they were big, cumbersome machines lacking many of the improvements now considered so essential. The average weight of all tractors in the 1908 Winnipeg contest was 537 pounds per rated belt horsepower, and in 1910 it was 504 pounds. Contrast these, if you will, with a modern tractor which weighs in the neighborhood of 200 pounds per rated belt horsepower. As late as 1921, tractors of more than 100 belt horsepower were being offered to farmers and some of them actually were being sold. It was not until 1923, when the all-purpose tractor was developed to adapt it to row crop cultivation, that the death knell of the big farm tractor was sounded and manufacturers started to build their machines down to fit the needs of the family sized farm.

Despite the crudeness and working limitations of early tractors, they found a ready market. Farmers were interested in any new power unit or machine which would permit the timely performance of farm operations. On Jan. 1, 1920, according to the Bureau of the Census, there were 246,083 tractors on farms in the United States. Five years later, or in 1925, the count was 505,933, or a gain of more than 100 per cent. The next five years witnessed a gain of about 415,000, and the 1930 census showed 920,021, or a gain of 82 per cent over 1925. No census enumeration was made in 1935, but the *Farm Implement News* estimates 1,248,337 tractors on farms in the United States as of April 1, 1936.

While tractor, automobile and truck manufacturers had many problems to face in developing their products that were common to all three, the tractor manufacturer had others that were peculiarly his own. Chief of these was the adaptation of his machine to the uses for which it was intended. There are a multiplicity of farm operations, each requiring its own particular machine or implement, and when the tractor appeared in the field all of these machines had been designed to be used with animal power. When the early tractors went into the field they were hitched to horse-drawn implements and, naturally, they did not perform as well as might have been expected. Their power greatly exceeded that for which the implement was designed and frequently their speed was far in excess of that of a team of work animals.

It is doubtful if Cyrus Hall McCormick had any idea of the force that he set in motion with the introduction of his reaper in 1831. It was the beginning of a progress that revamped civilization.

Manufacturers of farm implements, foreseeing the strides to be made by the tractor industry, got busy re-designing and strengthening their machines to adapt them to tractor use, and this did much to increase the popularity of the tractor. But it did not entirely solve the problem. It required more than mere re-designing and strengthening horse-drawn machines to make them adaptable to tractor use. What it actually required was entirely new machines in many cases. These new machines had to be different in many essential parts, although performing the same functions as the horse-drawn model, to accomplish the best and most economical results when used with the tractor.

The introduction of the all-purpose tractor, with its high clearance and wide tread to straddle row crops and with many of its implements mounted on its frame, started the modern trend which is being rapidly developed. Sales of this type of tractor in the United States increased from 33.3 per cent of total tractor sales in 1931 to 71.3 per cent in 1935. No longer is the tractor merely an iron horse to drag implements about the farm but it is becoming the power unit of a large number of individual farm operating machines. When the kind of work changes as the farmer goes through his various operations of seedbed preparation, planting, cultivating and harvesting his crops, the tractor becomes the power unit of many kinds of machines. With a plow mounted on its frame, it is a plowing machine. The plow is taken off and a cultivator attached and it becomes a cultivating machine. Thus, with change after change, it is transformed into first one, then another kind of machine. Some of you may have seen a tractor-mounted corn picker. When the picker is mounted, it so completely hides the tractor from view as to lead one to believe that all one sees is a corn picking machine. And after all, that is really what it is, for the tractor is serving only as the power unit of a motorized mechanical corn picker. One tractor manufacturer builds 25 separate machines to be mounted on one model all-purpose tractor exclusive of those pulled behind the tractor.

It was only natural that this requirement for different types of farm machines of which the tractor serves only as a power unit, made it most practical for manufacturers of farm implements to take up the production of tractors, and at the same time, it made it quite difficult for tractor manufacturers who were not in the farm implement business to market their products. As time progresses and further expansion is made in the field of tractor operation, it is likely that every tractor manufacturer who expects to sell his product in volume to farmers will be compelled to provide the machines or attachments which will transform his tractor into various kinds of farm operating machines.

The introduction of the tractor came at a most auspicious time for the welfare of the American people. The once fertile lands of the East were losing their productivity as a result of continuous cropping but the rich prairies of the Great Plains were attracting settlers by the thousands. Their chief

(Turn to page 235, please)

Benefits from Longer Gaps in Sp

CAR manufacturers' specifications for spark-plug-gap size recently have shown a trend toward longer gaps. The reason, in most cases, is the belief that the use of these longer gaps results in better fuel economy or better idling. That there can be no such general relation becomes obvious when we reflect that a normal-size gap, of say, 0.015 to 0.018 in., will ignite and burn a homogeneous mixture with an air-fuel ratio of up to 16 to 1, without delaying the normal rate of combustion.

There are cases, however, where the position of the spark plug in the combustion chamber is such that the gap is poorly scavenged and where, consequently, the burnt gases from the preceding cycle dilute the fresh mixture to such an extent that, even if the mixture is ignited, the reaction spreads very slowly, causing a delay in pressure rise and resulting in "late" combustion. Stratification of the charge, which obtains more or less in all engines at part load, causes a non-homogeneous mixture to flow at a certain speed along the gap, with the result that consecutive combustion cycles vary in reaction rate, depending on the instantaneous mixture conditions in the vicinity of the spark plug at ignition, the pressure-time characteristics varying accordingly from cycle to cycle. Non-uniform mixture distribution makes matters still worse, as the "lean" cylinders will show the effects of slow, irregular burning more than will those which receive a normal mixture. Under these critical conditions, involving excessive dilution and stratification at the gap, and, perhaps, bad mixture distribution, a long gap may prove beneficial. At idling, when, in addition to the three basic facts already mentioned, low flow velocity in the induction system and low piston speed result in inherently-low inflammability of the mixture, conditions are worse than at part load; consequently a long gap improves matters in most cases.

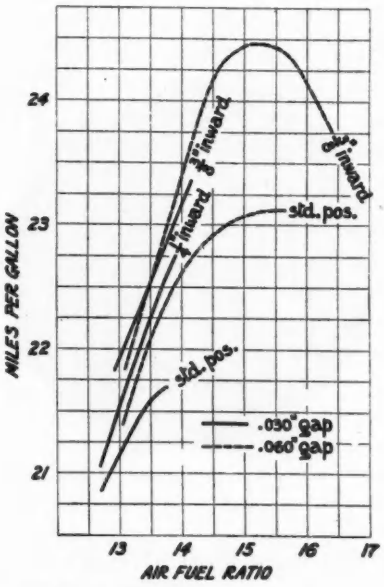


Fig. 2—Fuel-economy curves taken at road load corresponding to 20 m.p.h. on the level

In the speed range of 15 to 40 m.p.h. the gain in economy in some cases amounts to 2 to 4 miles per gallon. This is enough to warrant an analysis of the factors involved.

If combustion could take place during an unlimited time interval, the resulting peak pressure would depend only on the air-fuel ratio, the weight of the charge, and the heat losses through the chamber walls; but in an engine, the time available for the combustion (reaction) is limited by the engine speed; to obtain the maximum indicated power the pressure peak should be definitely located at the optimum point in the engine cycle. To meet this condition it is imperative that the burning of the mixture, once it has started, should progress without delay throughout the chamber.

Consequently, the time interval between ignition and the end of combustion (roughly, the pressure peak) is a deciding factor. Its length is determined by the flame speed, i.e. the velocity at which the reaction zone—the zone in which combustion occurs—travels from the ignition point to the walls of the chamber. Movement of the reaction zone is made up of two components, the first due to progress of the burning zone relative to the unburnt gases (reaction); the second due to expansion of the burnt gases (mass movement). Of these two components, the reaction rate is determined by the mixture characteristics (fuel, air-fuel ratio, turbulence, mixture temperature and pressure); the mass movement, on the other hand, depends on the relation of the burning gas volume to the burnt and unburnt volume, the distance of the chamber walls from the instantaneous flame front, the volume changes caused by the piston movement, and some other, less important factors.

Assuming a properly-functioning

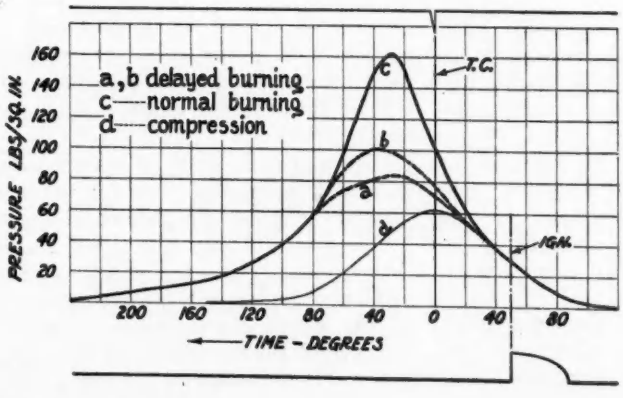


Fig. 1—Pressure-time records of normal and delayed combustion

By Hector Rebezzana
and Stephen Kalmar*

Spark Plugs

Depends upon the ability of the ignition system to supply sufficient voltage to jump the gap under required load conditions

ignition system, the spark ignites a certain minimum amount of the mixture; the heat generated by the combustion of this initial volume must be sufficient to raise the adjacent layer of unburnt gases to the ignition temperature. After that the reaction becomes self-sustaining. If, for any reason, the mixture in the vicinity of the spark plug is very lean, or too much diluted with remnant exhaust gases, immediately after ignition the rate of combustion will be very low and the indicated power will show a marked drop. Such delayed combustion is represented by lines "a" and "b" in the pressure-time record (retraced from actual part-load oscillograms) in Fig. 1. It will be seen that with such slow combustion there is hardly any pressure rise from ignition to top center. Line "c" is the pressure rise for normal combustion. In all three cycles ignition occurred at 50 deg. before top center. In fact, the three cycles are taken from a continuous record of about thirty consecutive cycles at part load. As the piston movement and all other factors determining the flame zone displacement were the same for all three cases, the low flame velocity and the delay in the pressure rise were evidently due to a slow reaction at the beginning of combustion, the cause of which was proved to be a mixture in the vicinity of the spark plug that was either too lean, badly diluted, or both.

To arrive at a sound conclusion, all other possible causes had to be investigated, and this was done in a series of tests on a single-cylinder engine and the multicylinder engine of a 1936 medium-size car. The only change from the car installation was the substitution of a variable-jet carburetor for the standard fixed-jet carburetor of the same type. The engine was installed on a dynamometer, and after the usual preliminary test runs, a fuel-economy test was made at 1000 r.p.m., corresponding to approximately 20 m.p.h. road speed, and at a constant load corresponding to the level-driving load at that speed. The procedure followed was to take fuel-consumption readings at progressively varying carburetor settings, keeping the load and speed constant by changing the throttle at each setting. The results are plotted against carburetor air-fuel ratio (determined by means of a Cambridge exhaust-gas tester) in Fig. 2. The first set of runs (full-line curves) was made with spark plugs having small gaps; one test with the gap in normal position, one with the gap ¼ in. into the chamber, and one with the gap ⅜ in. inward from the standard position. Special spark plugs having long electrodes were used. With the standard position the limit for steady operation

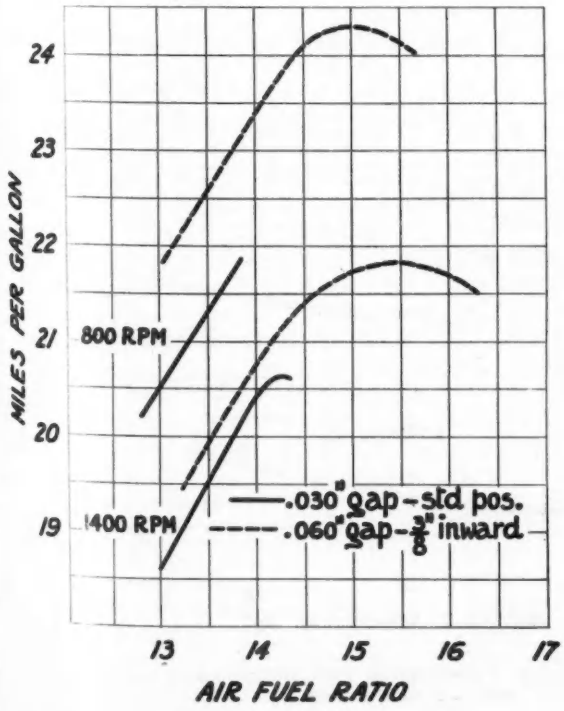


Fig. 3 — Fuel-economy curves taken at road loads corresponding to approximately 16 and 29 m.p.h. on the level

* A.C. Spark Plug Co., Flint, Mich.

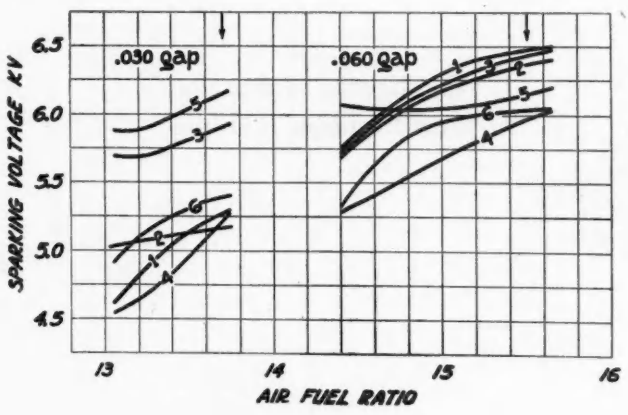


Fig. 4—Sparking-voltage readings pertaining to economy curves in Fig. 2

was an air-fuel ratio of 13.75, while the fuel mileage was 21.7 per gal. Letting the gap protrude ¼ in. into the chamber increased the mileage (for an air-fuel ratio of 13.85) to 22.75, and having the gap at ⅜ in. from the standard position gave a mileage of 23.4 at an air-fuel ratio of 14.15.

The second set of runs (dotted curves) was made with long gaps in the spark plugs. The first test, with the gap in the standard location, gave an air-fuel ratio limit of 15.65, with an economy of 23.1; in the second test the gap was set ⅜ in. inward and the results were a limiting air-fuel ratio of 16.3 and a maximum economy of 24.5 miles per gal.

These results showed that there is in this case a gain in economy both when the spark plug gap is moved into the chamber and when the gap width is increased.

Another series of similar runs, at speeds corresponding to 16 m.p.h. and 28 m.p.h. respectively, showed the same relative gains (see Fig. 3). In these runs the comparison was made between the small gap in the normal position and the large gap moved ⅜ in. into the chamber.

As to the possible cause of this difference in part-load performance, the assumption that it was the higher sparking voltage required by the longer gap, and the resulting greater power in the spark, was discarded; voltage readings taken during the runs of Fig. 2, small vs. large gaps, normal position, and plotted in Fig. 4, showed no appreciable difference in the sparking voltage. The two positions indicated by arrows show a difference of 1¼ miles per gal. (see Fig. 2) while the range of voltage is the same. On the other hand, part-load tests with illuminating gas as fuel did not show any difference between small gap normal position against large gap ⅜ in. in the chamber (the two extremes). The results of these tests are plotted in Fig. 5; the loads (constant) of 5.3 and 8.0 lb. were selected because they corresponded to road-load throttle positions when gasoline was used. The negative results of the runs with illuminating gas indicate either that the mixture distribution with carburetor mixture is poor and some of the cylinders get weak mixtures, or else that there is a layer of stratified, poor (lean or diluted) mixture in the vicinity of the spark plug which delays the combustion at the start. A mixture distribution test using the spark-plug temperature method (*), made at fixed throttle settings covering road-load conditions, showed fairly good mixture distribution; two of the cylinders were found somewhat leaner than the rest, but not lean enough to account for the difference. Furthermore, using a large gap or moving the gap position would not help if poor distribution were the only trouble. One might even assume that by moving the gap ⅜ in. into the chamber, the volume distribution in the combustion chamber, and consequently the P-T characteristics, would be changed; but this reasoning is not logical if one considers that the gain was not due to more power in *every* cycle, but to the fact that *more* cycles were burning normally in one case (large gap or deep gap location) than in the other case (small gap, or normal location), as resulted from tests in the single-cylinder engine.

Considerable experimenting had to be done with the single-cylinder engine until the conditions found in the multicylinder job could be duplicated. In the final set-up, the plug location, valve timing, and the exhaust back pressure were as nearly as possible the same as in the multicylinder engine. The throttle was set to give approximately 20 per cent of full load (with a maximum-power mixture), and the carburetor was leaned down to give an air-fuel ratio of approximately 18:1. Under these conditions pressure-time cards were taken of, say, 30 to 40 consecutive cycles, using first a small gap, then a large one, all other factors being kept constant. The same procedure was repeated at successively increased spark-advance settings. The pressure-time records are shown in Fig. 6, while the observed beam load readings are plotted against spark advance in Fig. 7. Each of the pressure records shows (at the bottom) a single cycle with the primary current for timing, and (at the top) a group of 35 to 40 consecutive cycles.

An inspection of these records shows, first, that, generally, the pressure cycles are not uniform; some give evidence of a very slow initial combustion, some of a normal burn. Second, that the slow burning can be partly compensated for by advancing the spark. Third, that with the large gap the combustion, as evidenced by the pressure

* See AUTOMOTIVE INDUSTRIES of March 19 and 26, 1932.

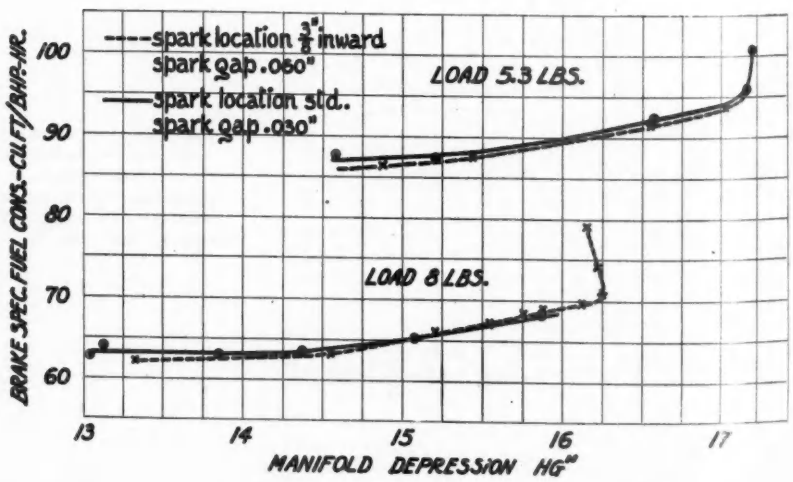


Fig. 5—Specific-fuel consumption with illuminating gas at constant part loads

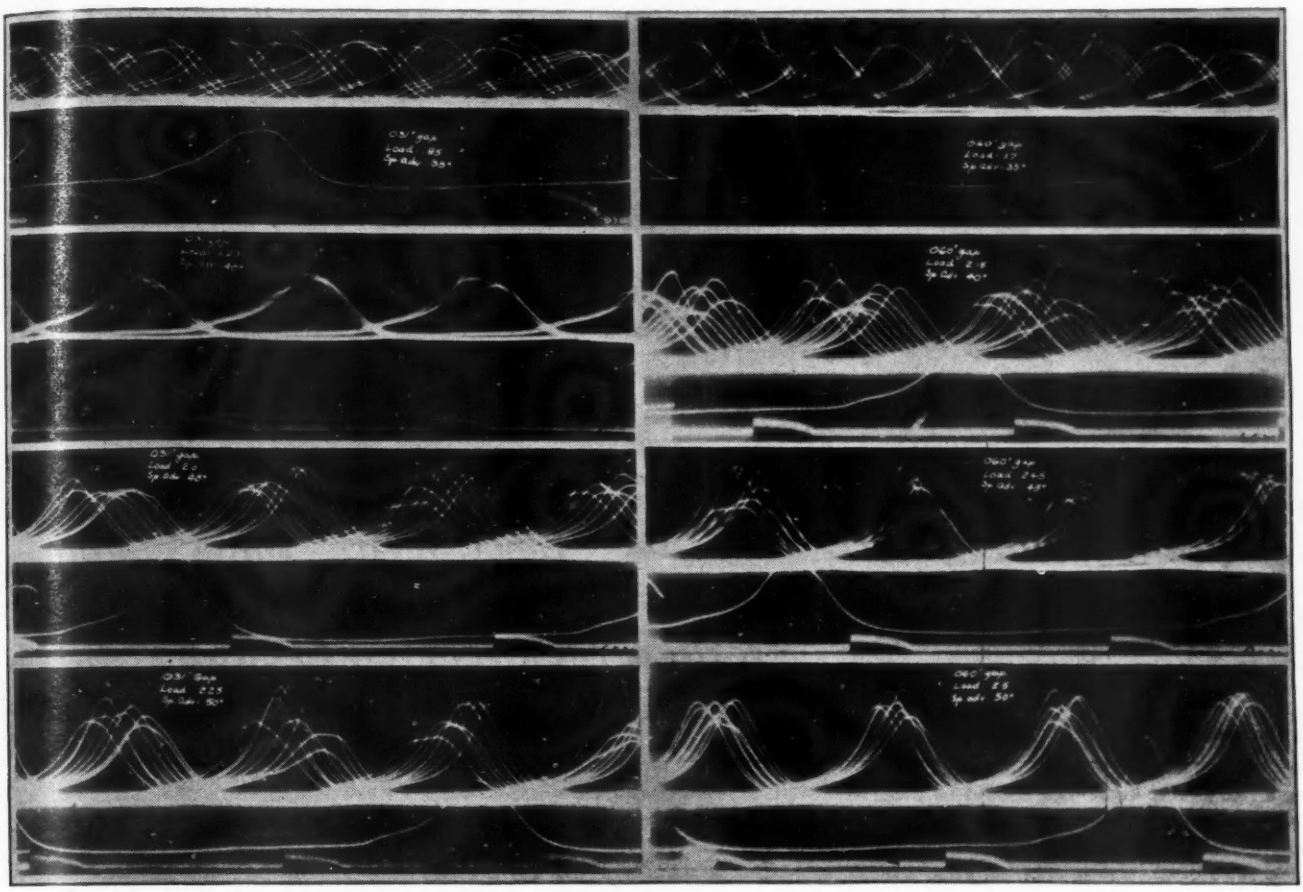


Fig. 6—Pressure-time records taken at a constant part-throttle setting for different gap sizes and spark advances as shown below in the same order that the illustrations appear

0.031 in. gap Load 0.85 Spark advance 35 deg.	0.060 in. gap Load 1.7 Spark advance 35 deg.
0.031 in. gap Load 1.20 Spark advance 40 deg.	.060 in. gap Load 2.15 Spark advance 40 deg.
0.31 in. gap Load 2.0 Spark advance 45 deg.	0.060 in. gap Load 2.45 Spark advance 45 deg.
0.31 in. gap Load 2.25 Spark advance 50 deg.	0.060 in. gap Load 2.5 Spark advance 50 deg.

rise, is faster, and that for a given number of consecutive cycles the large gap gives more normal cycles than the small gap, which results in a higher beam load (see Fig. 7) and, consequently, a higher fuel economy. No records were made with a plug-gap position deeper in the chamber, but repeated tests have conclusively proven that unless all the factors contributing to this peculiar part-load condition are present (i.e. lean mixture, spark plug location, valve timing, exhaust back pressure and throttle opening) no difference can be found in load and fuel economy, whether a large or small gap is used.

From these test results it can be concluded that this critical part-load condition is due primarily to a stratified mixture in the vicinity of the spark plug, which varies in inflammability from cycle to cycle. Most probably the cause is insufficient scavenging (valve timing, exhaust back pressure), the effect of which increases with decreasing throttle opening.

Of the three most important remedies, advancing the spark compensates for the slow-burning mixture at start; changing the plug location puts the gap into a more ignitable mixture, and, finally, increasing the gap length increases the probability of igniting a good mixture, as the stratified mixture flows along the gap, because of the discharge characteristics of large gaps. Preliminary investigation indicates that it is the ability of the latter (or secondary) portion of the discharge of long gaps to ignite the mixture flowing through the gap, that results in the difference observed in their performance, when compared to short-gap plugs. Apparently, both long and short gaps in the range studied produce ignition during the initial portion of the discharge. The short gaps did not seem to possess any additional igniting power and, hence, whatever type of mixture happened to be in the gap at the time the first stage of the discharge took place, was ignited and was thus the determining factor of the subsequent rate of combustion. The long gaps, on the other hand, did seem able to ignite, in addition to the mixture in the gap at the beginning of the discharge, any mixture that might appear in the gap space during the life of the discharge. According to what we know about the effect of mixture ratio on reaction rate the tendency would be to speed up the reaction and the pressure rise.

With the present trend in carbure-

(Turn to page 229, please)

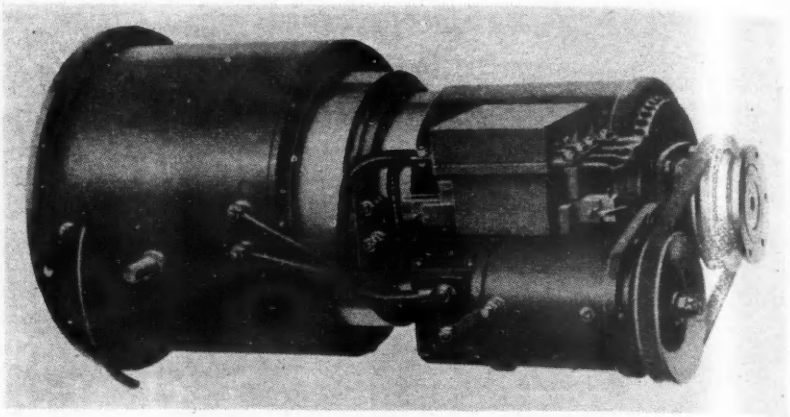


Fig. 1. The "Electrogear" unit

With the "Electrogear" some engine power is converted into electric power, then reconverted to change the ratio of input torque to output torque. P.M.Heldt describes this

New Electro-M

AN electro-mechanical transmission for automobiles, railcars, etc., of a type in which part of the engine power is always transmitted mechanically while the remainder is converted into electric power and then reconverted, in such a manner as to automatically change the ratio of input torque to output torque, has been developed and is to be marketed under the name "Electrogear." Compared with the conventional electric drive, in which all of the engine power is always converted into electric power and the latter reconverted into mechanical power, the new transmission should show a considerably higher efficiency, because the conversion of power from one form into another is always attended with loss, and if only a fraction of the power generated by the engine is thus converted and reconverted, the loss should be proportionally smaller. The proportion of the engine power which is converted into electrical power varies with the "gear ratio," that is, with the ratio of crankshaft speed to output-shaft speed.

On starting from a standstill with the propeller shaft stationary, when the throttle is suddenly opened wide for quick acceleration, nearly all of the power generated is converted, whereas under normal driving conditions the proportion converted varies between 5 and 30 per cent.

The Electrogear is in the form of a handy unit (Fig. 1), that is flanged to the rear of the engine block and has the propeller shaft connected to its output shaft through the intermediary of a universal joint. It comprises a booster dynamo driven directly by the engine, a differential gear of the planetary type, a reducer dynamo whose armature is connected to the engine crankshaft and the output shaft through the differential gear, an electrical circuit including the two dynamos and a control switch, and a regulator dynamo whose current is used to vary the magnetic field of the booster dynamo. A longitudinal section through the axis of the booster and reducer dynamos is reproduced herewith (Fig. 2), and shows the arrangement of the parts quite clearly.

The field frame of the booster dynamo is bolted to the engine block, and the field frame of the reducer dynamo is bolted to that of the booster dynamo, the two fields together forming a housing for the complete transmission. The small regulator dynamo is arranged with its axis parallel to that of the transmission, near its rear end, and is bolted to it. It is driven by a V belt from a pulley on the propeller shaft.

From the sectional assembly drawing it can be seen that the armature of the booster dynamo is built on a cylindrical shell or drum, within which is located the differential gear. The latter is of the planetary type, consisting of a sun pinion, three planetary pinions, and an internally-toothed ring gear, the planetary pinions meshing with both the sun pinion and the ring gear. Both the armature of the booster dynamo and the ring gear are rigidly secured to the crankshaft, and therefore always rotate with it. These parts, moreover, serve as flywheel for the engine, taking the place of the conventional flywheel. At its rear end the booster armature is supported by a ball bearing mounted in a bulkhead of the transmission housing. The planetary carrier is splined to the forward end of the output shaft of the transmission, while the sun pinion has a hub or lateral extension that is splined to a tubular shaft carrying the armature of the reducer dynamo.

To assure quiet operation under all conditions, the gears of the differential are cut with helical teeth. The differential is completely enclosed in a separate housing through which oil from the engine lubricating system is circulated, the oil entering through a nozzle in the rear end of the crankshaft and leaving through outlets at a considerable distance from the axis, being caught in a collector ring from which it drains back into the crankcase.

The commutators of the booster and reducer dynamos are located adjacent to each other at the middle of the transmission, and the brush riggings are rendered accessible by removing cover bands from the housing. Both dynamos are provided with interpoles, to prevent destructive arcing, thereby assuring long service of both brushes and commutators.

A car equipped with the Electrogear is controlled by means of a switch on the dashboard and the accelerator pedal. The switch needs to be manipulated only while the car is at rest. It has four positions: cranking, forward, reverse, and neutral. Operation of the switch alone will not start the car. Neutral position is used only for warming up the engine.

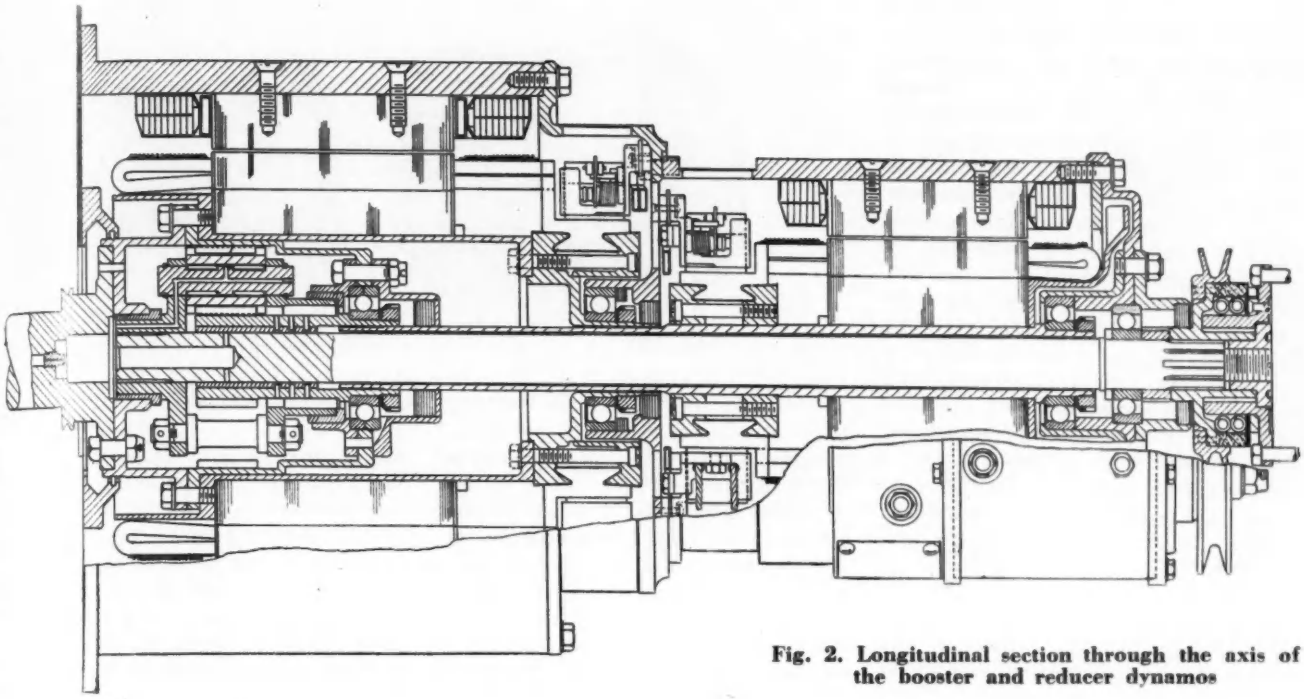


Fig. 2. Longitudinal section through the axis of the booster and reducer dynamos

Mechanical Transmission

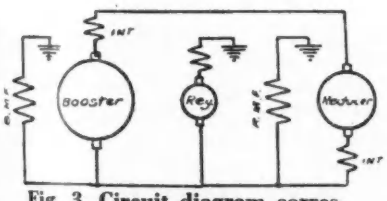


Fig. 3. Circuit diagram corresponding to the "Forward" position of the control switch

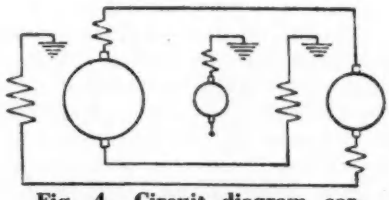


Fig. 4. Circuit diagram corresponding to the "Reverse" position of the control switch.

When the switch is turned to the cranking position, the booster dynamo is connected to the car battery and acts as a starter motor, cranking the engine over. Thus no separate starting motor and drive are required. The battery is kept charged by the usual charging generator. Next the driver turns the switch to the forward position, but, as already stated, this does not start the car. A starting torque can be produced only by applying a reactive force to the sun pinion, and this reactive force has to be produced by the reducer dynamo. The reason no such reactive force is produced when the switch is turned to the forward position is that the circuit including the two dynamos is still open, and the reducer armature therefore can spin freely. Closing of the circuit is effected by the first part of the downward motion of the accelerator pedal. Further depression of the pedal opens the throttle valve. A diagram of the circuits corresponding to this control position is shown in Fig. 3. The circle at the right represents the armature of the reducer dynamo, which at first acts as a generator. The small circle in the center represents the armature of the regulator dynamo, and the large circle on the left the armature of the booster dynamo. All field windings are series-connected.

The planetary carrier being in driving relation with the driving wheels of the car, there is considerable resistance to its rotation, and when the engine is first speeded up, rotation of the ring gear (with the crankshaft) results in rotation in the opposite direction of the sun pinion and the reducer armature connected to it. Current generated by the reducer dynamo passes through the booster dynamo, which now acts as an electric motor, generating driving torque which is added to that of the engine. The current generated by the reducer dynamo and the torque produced by the booster dynamo increase and decrease with the speed of the reducer armature, as does also the reactive force generated by the reducer dynamo and impressed on the sun pinion of the differential. As a result of this reactive force, torque is transmitted from the ring gear to the planetary carrier, and the car is accelerated. The tangential force impressed on the studs carrying the planetary pinions is evidently the sum of the forces on the ring-gear pitch circle and the sun-pinion pitch circle, which forces are equal, so that the tangential force on the planetary stud circle is equal to twice the force on the ring-gear pitch circle, and

as the radius of the differential-stud circle is considerably more than half as large as the radius of the ring-gear pitch circle, the differential gear under these conditions increases the torque.

The switch operated by the accelerator pedal connects the regulator dynamo to the booster dynamo, as shown in Fig. 3. The object of the regulator dynamo is to modify the magnetic field of the booster dynamo. The electromotive force generated by the regulator dynamo is impressed on the field winding of the booster dynamo and acts in opposition to the electromotive force normally impressed on this field, which originates in the reducer dynamo. As the regulator dynamo is driven at a speed proportional to car speed, its electromotive force increases with car speed. Therefore, the effect of the electromotive force generated by the regulator dynamo is to first weaken the booster dynamo field, and later, at higher car speeds, to reverse that field and convert the booster from a motor to a generator. Thus with increasing car speed the booster field is weakened and the torque produced by the booster dynamo decreases. More and more of the driving torque is supplied directly by the engine, so the latter is prevented from attaining excessive speeds. This continues until the booster no longer supplies any torque to the differential and the reducer armature has almost come to a stop from its rotation in the reverse direction (as compared with the direction of crankshaft rotation). Under these conditions less than 5 per cent of the engine power (just enough to maintain the circuit) is converted into electrical power, the remainder being transmitted mechanically through the differential to the output shaft. The torque on the output shaft is now equal to the product of engine torque by the gear ratio, which latter for the proportions shown in the sectional drawings is about 1.4. At low speeds, owing to the combination of the booster torque with the engine torque, the torque multiplication (or speed reduction) is greater, of course.

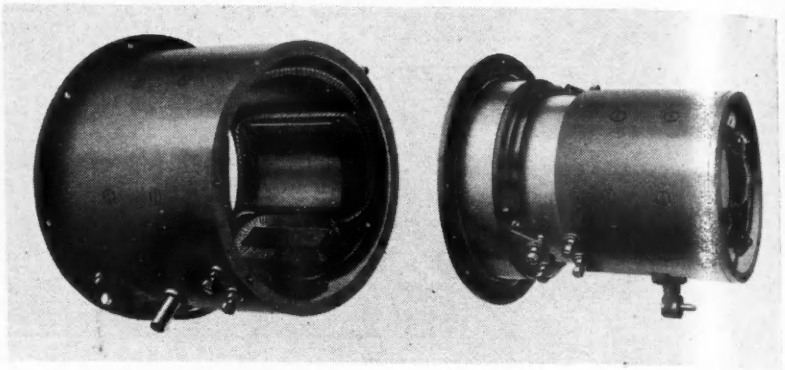


Fig. 5. Field frames of booster and reducer dynamos

As the car speed increases further, the regulator dynamo reverses the field of the booster dynamo and makes a generator out of it. Current from the booster dynamo then passes through the reducer dynamo, which, acting as an electric motor, starts to turn in the opposite direction, that is, in the same direction as the engine crankshaft. With both the ring gear and sun pinion rotating in the same direction, the ratio of crankshaft speed to output-shaft speed (the reduction ratio) decreases further, and when the reducer armature has attained a speed equal to that of the crankshaft, the differential rotates as a solid unit and the drive is direct. Under this condition the booster dynamo, acting as a generator, imposes a considerable load on the engine and therefore holds its speed down. However, the booster dynamo continues to build up as a generator, thus further speeding up the reducer armature and the output shaft through the differential gear, until the propeller shaft turns at 50 per cent or more above crankshaft speed, giving an overdrive. One feature of this transmission is that the electrical units can be readily so proportioned that at maximum car speed the engine is operating at the peak of its power curve, whereas in a conventional car with the stepped transmission it usually operates considerably beyond this point.

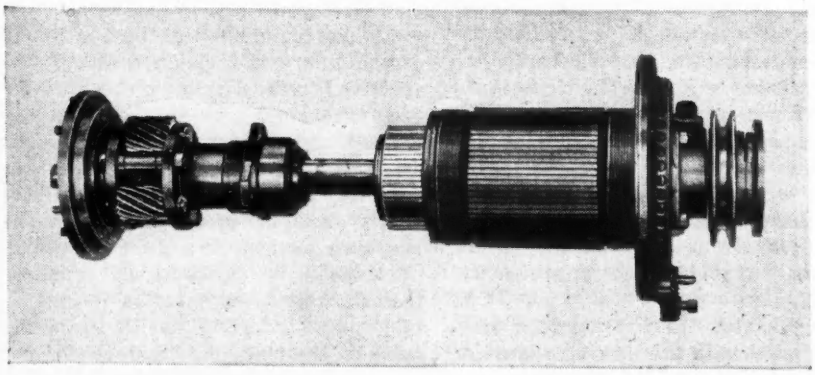
All speed variations are automatic, requiring no control other than the conventional movement of the accelerator pedal. In normal operation, as the driver releases the pedal, the torque on the output shaft and the current passing between the two dynamos are reduced. This immediately weakens the reducer field, but owing to the reduction in the speed and voltage of the regulator dynamo, the booster field is strengthened and the additional engine load due to the booster acting as generator holds the engine down to a moderate, uniform speed, often as low as one-half the speed of the output shaft.

To reverse the direction of the drive, it is necessary that the reducer armature turn in the opposite direction to the crankshaft and that the pitchline velocity of the sun pinion be greater than that of the ring gear, which means that the reducer armature must turn several times as fast as the crankshaft. In reverse, the booster dynamo acts as a generator and sends a current through the reducer dynamo in such a direction that the latter turns in the opposite direction to the booster armature. A circuit diagram corresponding to the "Reverse" position of the control switch is shown in Fig. 4.

It is evident that with this transmission there is a continuous variation in the torque ratio; in other words, it is of the infinitely-variable type. This change in torque ratio or gear ratio takes place automatically in accordance with the driving torque required and the accelerator position. There is no interruption in the driving torque when the speed ratio is changing. Under light-load conditions, an overdrive is obtained automatically, the driven shaft of the transmission then turning faster than the crankshaft. Maximum overdrive ranges from about 30 per cent at 30 m.p.h. to 50 per cent at 50 m.p.h.

The unit described in the foregoing,

Fig. 6. Armature of reducer dynamo with planetary carrier and pinions



when installed in a conventional chassis, replaces the transmission with its shift-lever assembly, the clutch and its pedal, the engine flywheel, and the starting motor. The fuel consumption is claimed to be less than with the conventional mechanical transmission. As the efficiency of the transmission itself cannot well be as high as that of a direct mechanical drive, the gain in economy must arise from the fact that the engine is operated at a lower average speed and a higher average torque load (overdrive feature), and it is well known, of course, that the economy of an internal-combustion engine increases with the load factor.

As designed for use on private cars, the Electrogear weighs about 5 lb. per hp., 90 per cent of this weight being accounted for by the electrical and 10 per cent by the mechanical units. This is about twice as much as the weight of the parts eliminated. The principal advantages of this transmission are that it completely eliminates clutching and gearshifting, provides the continuity of torque and the ease of control of the straight electric drive, and retains the efficiency of the conventional sliding gear transmission.

The Electrogear has been under development for a considerable length of time. The writer some time ago had the opportunity of driving a car equipped with it and found it to handle very satisfactorily in every respect. What impressed him most was the complete absence of that uncertainty or "nervousness" which one usually experiences when first driving a car with "nonstandard" controls. An extensive road test of an Electrogear-equipped car has been made by the Pittsburgh Testing Laboratory, and the results were checked by it against the performance of the same car with the conventional transmission. In its report the Laboratory makes the statement that "It is not conceivable that any operator having the choice would revert to the conventional transmission after having tested an Electrogear."

Manufacturing arrangements are now being made and it is planned to put through a considerable number of these transmissions with the object of demonstrating the market for cars equipped with them among motorists interested in improved control features.

Benefits from Longer Gaps in Spark Plugs

(Continued from page 225)

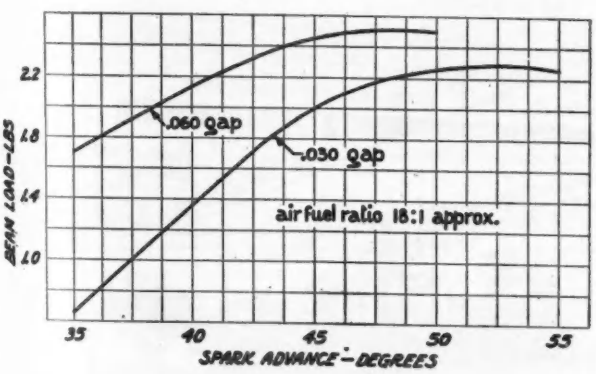


Fig. 7—Observed beam load readings for Fig. 6

tion methods and mixture control, which aims at the most economical part-load operation, it will be quite difficult to avoid having a few cylinders in which the mixture in the vicinity of the spark plug is too lean or diluted (due to poor scavenging, etc.) under some part-load conditions. The best remedy in such cases is, undoubtedly, to change the gap position. Heretofore, plug location was determined primarily by considerations of power, smoothness, detonation control and idling; in the future, part-load economy should be added to the list. There is no general rule for the best gap position for part-load economy; it depends on many factors, of which chamber design, flow resistance in the chamber, and valve location are only a few. The method of ionizing gaps adopted by the authors (*) is one quick and efficient way of finding the proper location.

Another way of getting results is to advance the spark. This is critical, because usually only a few cylinders need it; the others will then have too much advance, which may or may not hurt their performance.

The benefits one may derive from a long gap depend entirely on the ignition system. Although a long gap does not require higher voltage at part load (see Fig. 4), it does very much so at full load; therefore, the question of the limiting gap length depends entirely on the ability of the secondary of the ignition system to supply voltage required to jump the gap, under conditions of high speed, full load, with shunted (coated) plugs.

It may be pointed out in this connection that in extreme cases, secondary-coil polarity should be chosen for maximum power delivery and should not be left to chance; that spark plugs with small electrodes possess lower sparking voltage than plugs with similar electrode materials of larger diameter; that long ignition cables running parallel to each other, or to the engine, cause ignition energy losses large enough to influence the ignition performance materially; that electrode temperature is also a very important factor in sparking voltage—the higher the temperature the lower the sparking voltage—and that "flashover" on a spark plug means an abnormally high sparking voltage at the gap, this high voltage being made necessary by extreme leanness of the mixture at the gap.

* AUTOMOTIVE INDUSTRIES, March 2, 9 and 16, 1935.

Commercial Bodies from Largest Fabricating Shop

serves all Chevrolet assembly plants with cab stampings and sub-assemblies of body units with a capacity of 2000 bodies per day.

By Joseph Geschelin

LAST December marked the opening of what is considered the largest fabricating plant in the world devoted to the production of commercial vehicle bodies. We refer to the new Chevrolet commercial body plant at Indianapolis which has a capacity of about 2000 bodies per day and has been shipping the 1937 standard cabs at the rate of 1200 units per day.

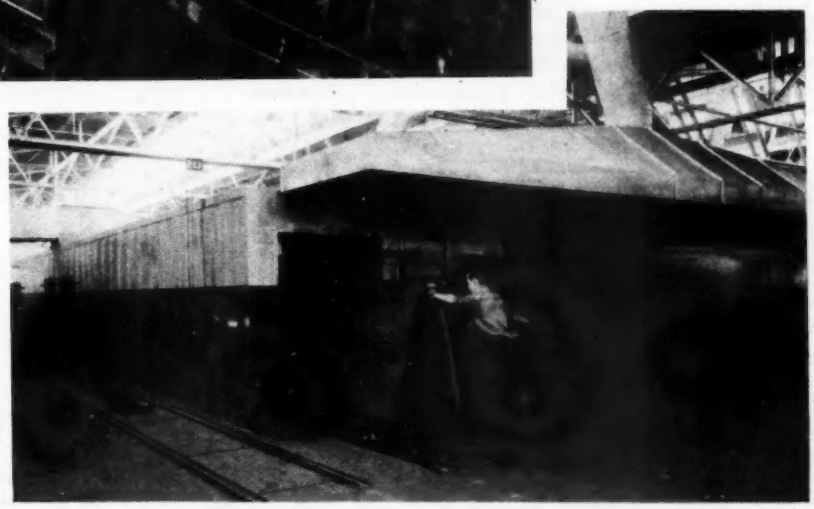
This plant is designed to serve all Chevrolet assembly plants with cab stampings knocked down in sets, and sub-assemblies of body units which are assembled at points of use. All parts are shipped in the white or in prime coats for finishing at the assembly plant.

The new plant rose on the site of the old Martin-Parry property and provides some 500,000 sq. ft. of floor space on a 40-acre tract. The essence of modernity is found not only in the ultra-modern building construction and new equipment but in the planning of the entire operation since the layout of

(Below) General view in main assembly building showing body side assemblies in the foreground. In the center may be seen the battery of three welders for assembly of small body sides.

Partial view of the battery of four huge clearing presses used for producing the big steel tops for 131 in. wheelbase bodies. Behind this row of presses are the two inclined Cleveland presses which produce the reveals at the front and back end of the top stamping.

(Below) Oven with controlled temperature zones is used for drying undercoats. This oven takes all types of large units such as body sides and tops which are seen at the entering end.



buildings and departments is based upon the flow of materials from the receiving department to the shipping docks. In all, there are over three miles of conveyor lines to facilitate this flow.

That worker comfort was one of the prime considerations is obvious even to the casual observer. In the first place, practically 75 per cent of wall and roof area is fitted with glass so as to afford the maximum benefit of natural light; for artificial illumination, the entire plant is provided with the new high intensity mercury vapor lamps developed by G. E. In addition, there is a modern ventilating system utilizing fans of the heating system which are spaced in the roof trusses at intervals of 80 ft. This is said to assure an ample supply of cool air in summer and heated air in winter.

As a further step along this line, all spray booths are of the water-wash type built by R. C. Mahon with a positive exhaust draft system which draws off the fumes and vapors while circulating an adequate supply of filtered air. The best evidence of the efficacy of these spray booths may be gaged from the fact that the operators work comfortably without the use of masks or other protective devices.

The building is designed in the form of a large "L" with the long leg housing the various finishing operations while the short leg is devoted to press shop equipment. With this layout in mind, visualize raw materials coming in on a spur track which runs parallel to the long leg of the "L" and feeding to the receiving bay at the extreme end of the press shop. The long rows of press lines originate at the receiving bay and run the length of the building at right angles to the long leg of the "L."

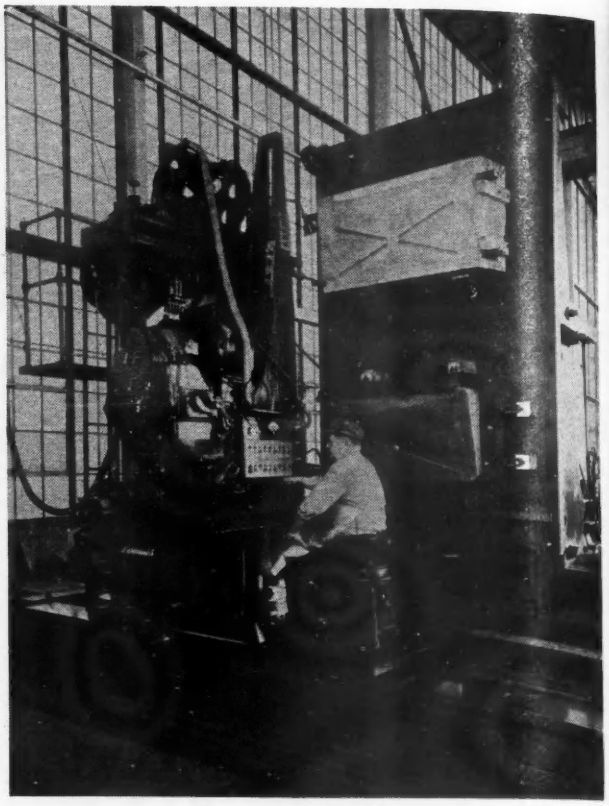
The entire press shop building is traversed by a system of overhead monorail conveyors which link the presses and transport finished stampings to the sub-assembly and finishing operations. In general, the plant serves the function of fabricating sub-assembly units of the commercial body line, these being shipped to the various assembly plants for final assembly and finishing operations. The only exception to this, at the moment, is in the production of the standard cab. For this unit the plant makes stampings only and ships complete sets of stampings directly to the assembly plants without making up sub-assemblies.

The latter arrangement makes it possible to set apart some press lines exclusively for the cab; also to provide a separate conveyor system which traverses the press line and continues directly to the shipping dock.

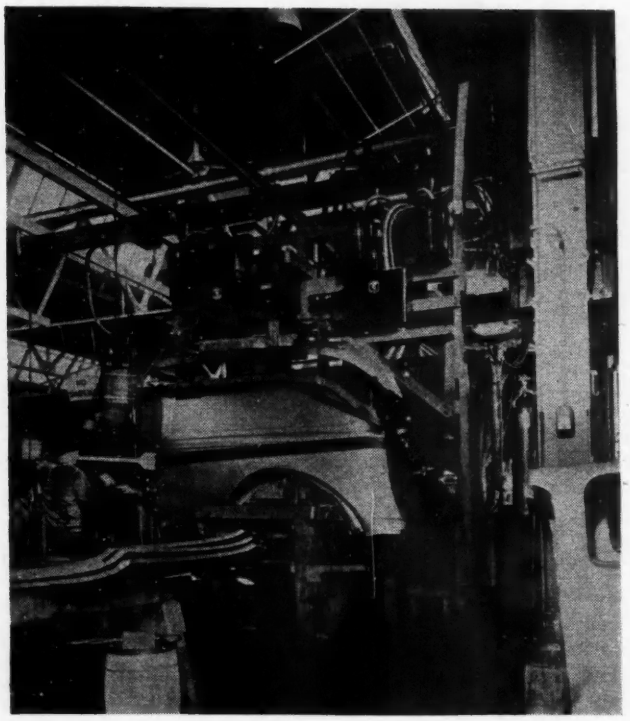
The plant is set up to produce the following body units: tops, platforms, body side assemblies, rear doors, driver's seat assemblies, and cab parts. Scheduling of work starts with definite shipping instructions from the central planning office in Detroit. Production is then based upon some reasonable volume, taking into consideration the definite shipping schedule, future requirements, and minimum banks of certain parts.

Tracing the flow of work through the plant, we find first that the press shop handles stampings as well as certain light welding operations essential to a stamping sub-assembly. Stampings then move into the other building and proceed to various departments which are arranged in the following order:

Welding and assembly.
Metal finish.
Primer and surfacer.
Rubbing deck.
Trim shop.
Shipping.



One of the two Pratt & Whitney Keller die-making machines in the die shop set up on a die job.



Close-up of body side assembly buck. These fixtures are designed to take every standard variety of body side without change. Each machine has its own transformers feeding portable gun welders.

Perhaps the largest stamping made in the industry is the turret-top for the 131-in. wheelbase job. This takes a blank size of 72 in. by 171 in. and requires press dies weighing upwards of 35 tons per set. Four huge Clearing presses are set up for the top, one of these, rated at 900 tons capacity, being the largest in use anywhere.

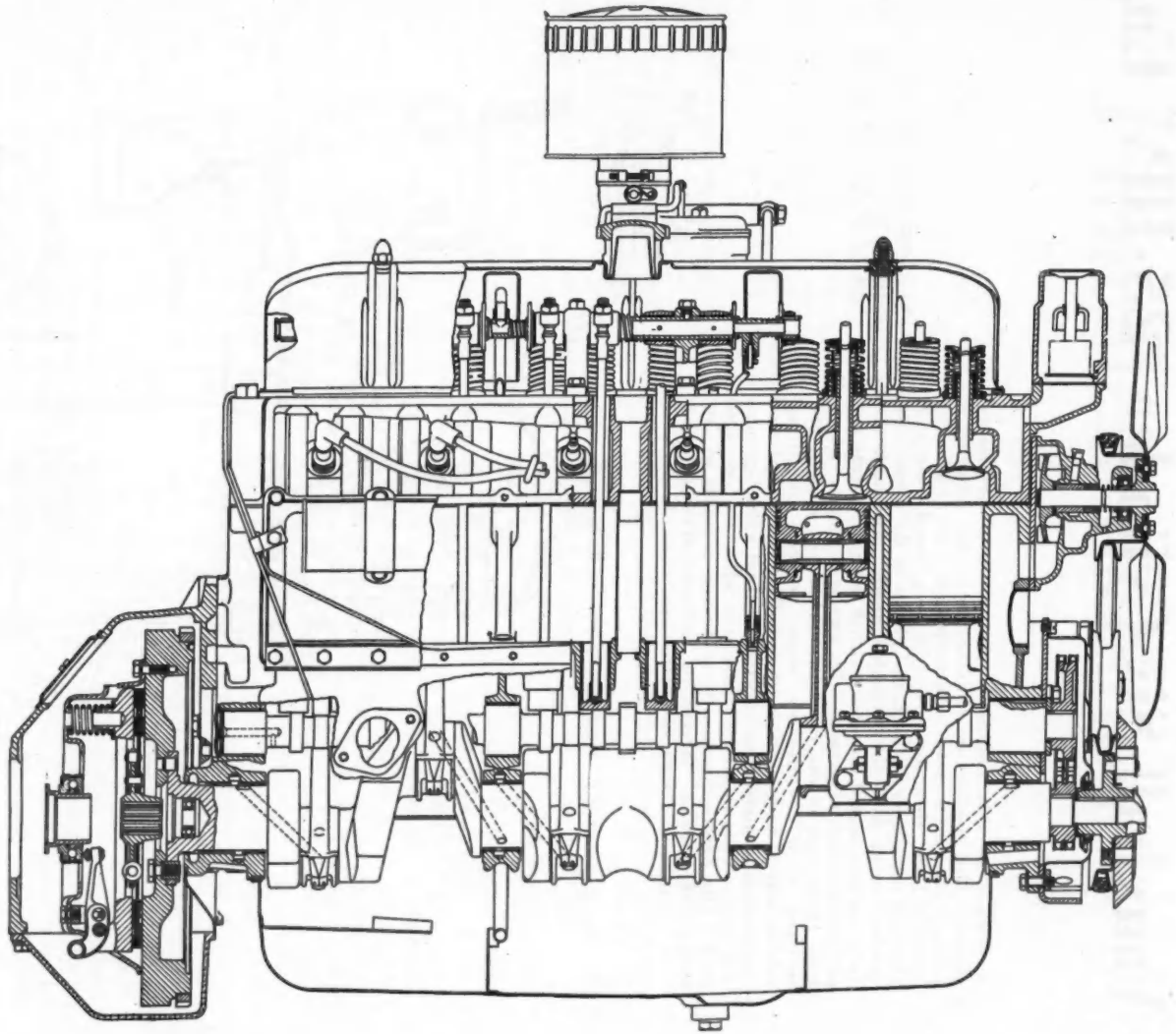
Quite an interesting problem was presented in developing the tooling for finishing the reveals for the front and rear sections of the top stamping. Here is a comparatively small detail but it's tacked on to the end of an extremely long stamping. It was worked out very cleverly by inclining two Cleveland presses at an angle of 45 deg. to the floor, the press bed being sufficiently high off the floor to accommodate the end of the stamping and yet accessible to the operator from a raised platform. This arrangement has saved considerable floor space and tooling expense.

As is customary, all large blanks are fed through McKay roller leveling machines before going to the presses. An interesting feature of the operation here is that many formed blanks are purchased directly from the steel mills, thus achieving an important economy by eliminating blanking presses as well as the floor space required for their installation.

The welding department has some interesting features. For example, we

(Turn to page 237, please)

Vauxhall Six-Cylinder "25-HP." Engine

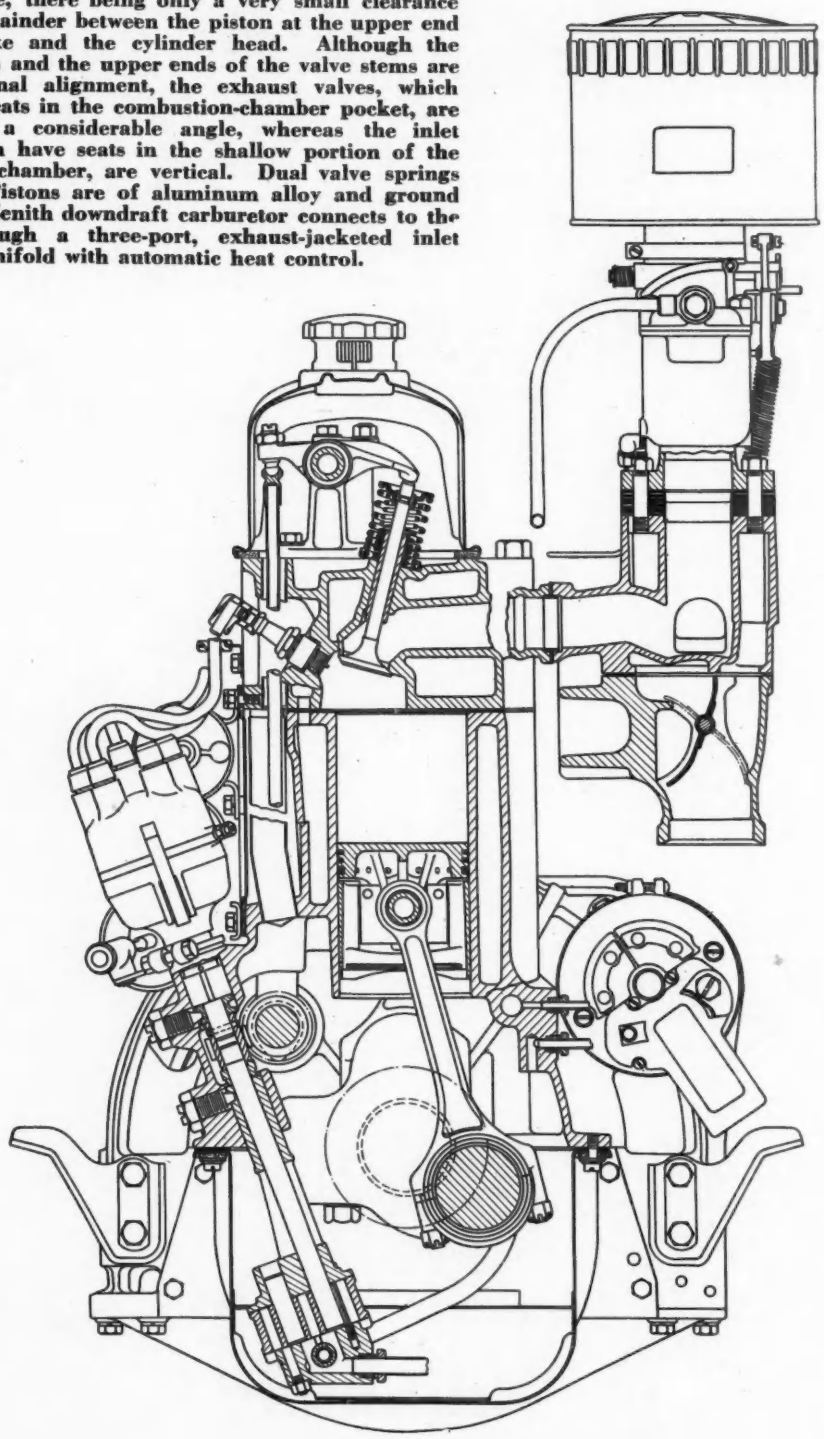


This engine has a bore of just under 3¼ in. and a stroke of 4 in., which dimensions give it a displacement of 196.1 cu. in. The compression ratio is 6.1 and the rating, 80 b.hp. at 3600 r.p.m. Of the four main bearings the front one has a diameter of 2 1/16 in. while the other three have diameters of 2¼ in. Crankpin bearings are 2 in. in diameter. The Vauxhall company is a General Motors subsidiary and a certain similarity between this overhead-valve engine and the Chevrolet will be recognized.

No. 13 in the AUTOMOTIVE INDUSTRIES Series of Engineering Drawings

Vauxhall Six-Cylinder "25-HP." Engine

A feature of this engine is the combustion-chamber shape. The combustion chamber is in the form of a pocket extending over approximately one half the cylinder bore, there being only a very small clearance over the remainder between the piston at the upper end of the stroke and the cylinder head. Although the valve rockers and the upper ends of the valve stems are in longitudinal alignment, the exhaust valves, which have their seats in the combustion-chamber pocket, are inclined at a considerable angle, whereas the inlet valves, which have seats in the shallow portion of the combustion chamber, are vertical. Dual valve springs are used. Pistons are of aluminum alloy and ground oval. The Zenith downdraft carburetor connects to the engine through a three-port, exhaust-jacketed inlet manifold with automatic heat control.



Farm Mechanization

(Continued from page 221)

obstacle was a lack of economical power. It is true that there were plenty of horses and mules—far more than there are today—but the many idle months when they were not needed for work in small grain growing, which was the chief occupation in these districts, made the cost of power too high to be profitable. Tractors and big gang plows seemed to be made to order for such conditions. They enabled farmers to establish themselves in their new homes and make the addition to the National agricultural plant which our growing population required to remain on a self-supporting basis, so far as agricultural products are concerned.

During the depression, when most of our export markets were closed, our domestic consumption at an abnormally low level and our surplus stores of farm products abnormally large, much was said and written about over-expanded agriculture. Some went so far as to blame agricultural mechanization for over-expansion. These charges cannot be supported by statistical data for the simple reason that our agricultural plant has not increased in size or production volume as rapidly as our population has grown.

Larger Farms

For instance, in 1899, two years before the first tractor was sold to a farmer, we had 75.5 farms per thousand population; in 1929, we had only 51.2 farms. In 1899, we harvested 3726 acres of crops of all kinds per thousand population; in 1929, we harvested only 2898 acres. Had it not been for the expansion of our physical agricultural plant, a part of which was due, no doubt, to the introduction of mechanical power, a 1929 harvest equal in acreage to the 1899 acreage would have been only 2306 acres per thousand population, or 38 per cent less than was actually harvested in that year. Such a limited per capita acreage undoubtedly would have forced the United States to have become a larger importer of foreign-grown farm products.

Surely, there is no evidence of over-expansion in agriculture shown by those figures. On the other hand, it is doubtful if our agriculture, without the aid of the tractor and other power equipment, could have kept pace with our growing population which has increased about 67 per cent in the past 36 years.

It is often heard that the tractor, by displacing horses and mules on the farm, has caused farmers to grow other than feed crops, thus increasing the quantity of these to be marketed. What are the facts about this situation?

In 1920, we had 25.8 million horses and mules of all ages on American farms; harvested 349 million acres of crops of all kinds and had a population of 105.7 millions. If we assume that 77.4 million acres of crops were required to grow feed for work animals (three acres per head), there were 271.6 million acres left for producing crops for all other purposes. That was 2570 acres per hundred population.

Ten years later, or in 1930, the number of horses and mules on farms had decreased 19.1 million head, and crop land, harvested, had increased to 357.5 million acres. Our population in the meantime had increased to 122.8 millions. On a basis of three acres per head, it required 57.3 million acres to grow horse and mule feed, which left 300 million acres of crops for all other purposes. This, on a basis of 122.8 million population, was 2443 acres per hundred as compared to 253 acres 10 years previously.

But how about other classes of livestock that might be substituted to consume the feed no longer needed by horses and mules? Has there been any increase in these? The answer is no, so far as their ratio to the country's population is concerned. We had fewer cattle of all kinds, fewer cows and fewer swine per thousand population in 1930 than we had in 1920, despite the great decrease in the number of horses and mules. In fact, when one studies the situation one cannot help but wonder what would have happened if the number of horses and mules had not declined to make way for the meat and dairy animals in order that the production of these products might keep pace with the growing population.

"Probably the most significant effect of the increased use of power and machinery in agriculture has been the reduction in labor requirements per unit of crop production," according to the U. S. Department of Agriculture. We might properly state this in another way and say that the most significant effect of the increased use of power and machinery in agriculture has been to increase the number of crop units the farmer has to sell per unit of man-labor required to produce them. In other words, it gives the farmer a greater gross return for his labor.

Man-Power Less

Let us consider the extent to which machinery has reduced the man-labor requirements in harvesting an acre of wheat yielding 20 bushels. According to the U. S. Department of Agriculture, 47 man-hours were required when the sickle and flail were used. By the use of the binder and threshing machine this was reduced to six man-hours, and when the combined harvester-thresher and motor trucks for hauling are used, harvesting, threshing and storing grain can be performed by the expenditure of only about two man hours per acre. The user of the combined harvester-thresher equipment has three times as many units of wheat to compensate himself for his labor as does the one who uses the binder-thresher method, and about 23 times as many units as did the one who used the sickle and flail.

It was only through the use of labor-saving machinery which reduced the amount of man-labor required per unit of production that farmers were able to survive the economic changes that have taken place in this country in the past century, particularly the increases in earnings rates of non-agricultural workers. In their operations, farmers have several different wage scales to meet, their own and those of other industries whose products they buy for living and production purposes. Their own wages are determined by the relation between the prices they receive for their products and the number of man-hours they have expended in producing them. Obviously, the fewer number of hours of man-labor required to produce a given unit of

crop the greater will be the per hour rate of pay, regardless of what the selling price may be. If farmers' earnings rates are too low, they will be handicapped when they pay higher rates prevailing in other industries whose products they buy, inasmuch as wage rates always are reflected in the prices of the purchased products. This is what we call "lack of parity."

Labor Costs Controlled

In 1840, when it required about 47 man-hours to harvest an acre of wheat with the sickle and flail method, the average hourly earnings rate of wage earners outside of agriculture was 7.9 cents. At that rate, the man labor required to harvest an acre of wheat was worth $3.71 if sold in the non-agricultural market. In 1900, when the binder and thresher method was in common use in agriculture, about six man-hours was required to harvest an acre of wheat. Average hourly earnings of wage earners outside of agriculture in 1900 was 17.5 cents. At that rate, the man-hours required to harvest an acre of wheat was worth $1.05 if sold in the non-agricultural market. In 1934, with the use of the combined harvester-thresher and motor trucks for hauling, an acre of wheat could be reaped, threshed and stored with only two man-hours of labor. The average rate in non-agricultural industries in that year was 48 cents. At that rate, the man-hours required to harvest an acre of wheat was worth 96 cents in the non-agricultural market.

It was only through the use of machinery that farmers were able to keep pace with increasing rates in other industries. As wage rates increased in industries which supplied farmers, they met the situation by reducing the amount of labor required to produce their products and automatically brought about for themselves a higher rate of compensation. Without machinery, they long ago would have been submerged to a state of penury or peonage, or wage rates in other industries would have had to be maintained at a much lower level. In either event, from whence would have come our mighty purchasing power that created our varied industries and provided employment for millions of people?

During the past three or four years the tractor industry has made remarkable forward strides in improving its product and in adding new models to its line. Greater refinement in motors, with higher efficiency and substantial improvement in fuel economy, is one of the outstanding developments. Another is the addition of the small, or one-plow, tractor to the line. This makes mechanical power available for farms too small to afford sufficient hours of use to justify the capital investment in the smallest tractor available prior to the introduction of the baby unit. In addition the tractor has been mounted on rubber tires for both field and road work. Major improvements in the Diesel type motor, as well as in the other parts of the Diesel powered tractor, are also important developments in the tractor field, especially for the heavier units.

Thus, for nearly a century, "The Cavalcade of Farm Mechanization" has been marching on. How far will it go? Few men would care to hazard more than a guess. Those of us who are closer to the situation and who have taken the time and trouble to delve into the problem feel that our industry is still in its swaddling clothes. Of course we are proud of its past but we get more comfort and satisfaction out of contemplating its future. There are new jobs to be done by the tractor and its accompanying equipment. There are old jobs to be done in a better and more economical way. We are confident that we have solved most of the basic problems of design and construction and our main task now is the application of our power units to machines which will perform these jobs.

As to our sales possibilities, they seem to be almost unlimited when considered in the light of our past experience. We have about three million farms of 50 acres and over in size that are not yet using mechanical power. We have a million more that are smaller in size but large enough to justify the purchase of one of the smaller models that have recently come on the market. In the Corn Belt, alone, there are also about a million larger farms that can afford enough work for two tractors, a large one for plowing, disking and other heavy jobs, and a small one for cultivating, mowing hay and doing other light tasks. Many of these farms are now being so equipped. In the replacement field there are a million two hundred thousand tractors on farms which averaged older than seven years on January 1, 1936. Many of these will shortly be replaced.

The principal tractor customers, of course, are farmers, although there are many units going into other industries or sold for highway construction and maintenance. Our farmer customers have rejuvenated purchasing power as a result of higher prices for farm products. In view of smaller surplus stocks, soil conservation programs and abandonment of marginal and submarginal lands, it seems quite probable that their improved financial position will be continued for several years to come. They are now owners of more than four million automobiles. Can there be any doubt that they shortly will own as many, or more tractors?

Recent Achievements of the Oil Industry

FOLLOWING are a few points regarding developments in the petroleum industry on which emphasis was laid in a paper on "Cracking and Its Economic Significance," presented to the American Petroleum Institute at its recent annual meeting by Dr. Gustav Egloff of Universal Oil Products Co.:

Cracked gasoline was first produced commercially in the U. S. about 23 years ago, in shell stills having a capacity of 125 bbl. of gas oil per day, with a yield of 30 per cent of gasoline. At present a topping and cracking unit will treat more than 30,000 bbl. of crude a day, yielding 68 per cent of high-octane gasoline from such stocks as East Texas crude. Such a unit costs about $2,000,000, whereas the early shell stills cost about $20,000. The investment in cracking stills has risen from $2,000,000 in 1913 to more than $400,000,000 this year.

Polymer gasoline up to 100 octane rating is being produced from cracked gases. When all the units under design and construction are operating, they will produce at the rate of more than 300,000,000 gal. of gasoline a year, which will represent a yearly conservation of 53,000,000 bbl. of crude oil.

Polymer lubricants have high wear resistance in engines; and, when added to lubricants, they show a saving in some cases of 40 per cent of the oil.

It is estimated that there is a $10,000,000 chemical business a year based upon the utilization of anti-oxidants, dyes, and color stabilizers in motor fuels.

The use of control instruments in cracking units has tended toward more centralized control, thereby increasing length of runs, throughputs, yield, and quality of products.

The manufactured-gas industry has been seriously affected by the vast amount of refinery gases that have supplanted at least in part their regular product.

The production of fuel oil, coke, and gas from the cracking process is the equivalent of about 65 million tons of bituminous coal a year.

A host of chemical products is being produced from the treatment of cracked materials—such as resins, rubber substitutes, ethers, alcohols, glycols, acids, aldehydes, pickling agents, acetylene, sulfuric acid, etc.

Commercial Bodies from Largest Fabricating Shop

(Continued from page 232)

find two set-ups for body side assemblies—one for large sides, the other for small units. The small units go through a battery of three welding bucks fitted with gun-type tools; large units go through a battery of two bucks. In each case, the same jig has been designed to take the suburban, express, and open panel type body sides interchangeably without changing the set-up.

Another interesting piece of equipment is a big Hydromatic spot welder used for the pick-up box. This produces 49 spots in one setting and completes 68 assemblies per hour. The department also boasts a number of turntable welding fixtures for making lock pillar assemblies. Each machine has six stations, of which one is for loading and unloading. The turntable arrangement saves considerable floor space by comparison with the amount of room required for straight assembly tables customarily used for the purpose.

The metal finish department consists of two separate conveyor lines—one for tops, the other for body sides. In the paint shop we find a complete line of the water-wash spray booths, baking ovens of various types, and a water deck with a rubbing line conveyor. The paint shop produces surface coats only, the finishing color being applied after assembly at the various assembly plants.

At the very end of the long building is a large area devoted to the shipping department and its store rooms. Two spur tracks enter right into the building and permit comfortable working conditions regardless of the outside weather. A novelty in the shipping department is the arrangement of feeder line conveyors which dip and rise so as to clear the freight car doorways and thus facilitate unloading of parts from the floor level.

Aviation Fuels and Oils

A Course in Aviation Fuels and Lubricants. By Engineer M. S. Komsky. (In Russian.) Approved as a textbook in Red Army flying and technical schools, likewise in the Civil Air Fleet of the USSR. 206 pages with illustrations, including photographs, blueprints, etc. Price 2.25 roubles ($2.00). First edition, 18,000 copies. 1936.

THIS course describes the technology of fuels, their qualities, methods of exploiting various oils, organization of fuel economy, technology of lubricants, their characteristics and applications. Control of fuels and lubricants is also explained.

This study is designed for students who are already acquainted with the structure and operation of motors and with chemistry, as well as with the terminology and basic information on modern engines.

Gear Design Simplified

Gear Design Simplified. By Franklin D. Jones. Published by The Industrial Press, New York.

THIS course describes the technology of fuels, their qualities, methdesigner and shop man in producing various types of gears. The types of gears dealt with include spur gears, internal gears, straight-tooth bevel gears, spiral-bevel gears, helical gears for parallel-shaft drives, helical (spiral) gears for angular drives, herringbone or double-helical gears, and worm-gears. There is also a section on the figuring of speeds and ratios, which includes various transmissions of the planetary type. Another section contains rules and formulas for determining the power-transmitting capacities of different types of gears.

The book is printed in large type with large, clear illustrations. The reference is more to industrial than to automotive gearing, although, of course, the two types are practically identical.

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